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CONGENITAL DISLOCATION OF THE HIP[1]

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A FEW months ago, when I had the pleasure of receiving a visit from the Director General of the American College of Surgeons and I submitted to him a choice of subjects that I might present at the Clinical Congress, he advised me to speak upon congenital dislocation of the hip. He selected a subject of great practical importance indeed, but perhaps not the one most suited to rouse the interest of the general surgeon.

I accepted with pleasure, however, the advice of Dr. Franklin Martin because it gave me an opportunity to speak on a subject on which I feel competent to speak.

From the standpoint of my own experience, I want briefly to lay before you the facts which I consider all-important in dealing with congenital dislocation of the hip, namely, (1) its etiology and pathogenesis, (2) its diagnosis, and (3) its treatment.

ETIOLOGY

Concerning the etiology it is interesting to note that dislocation may be of hereditary and familial origin. From our statistics, which up to the year 1924 record 1,879 cases with a total of 2,556 dislocations, heredity plays a part in an average of 13 per cent; it is familial in an average of 10 per cent. The deformity is far more common in females. Our statistics reveal that 84.9 per cent of the cases were girls, 15.1 per cent boys, which would give us an average of eight girls to one boy. In 60 per cent of the cases the dislocations were single, in 39 per cent the deformity was bilateral.

It is curious to note the geographical distribution of the disease. In Italy, for example, we find the deformity frequent in the northern provinces, rare in the south, and almost unknown in Sicily. I am not in possession of precise information regarding the United States, but I am under the impression that the dislocation is far less common in North and South America than it is in Europe. It is certain that in the United States, dislocation is more common among the white than among the colored people.

From our statistics, it seems apparent that the hereditary factor cannot be overlooked. Notwithstanding the fact that the latest and most creditable theories of pathogenesis are inclined to point to the mechanical origin of the deformity, we are forced to admit that this theory does not fully explain every case of dislocation. At the same time the hereditary origin leads us to suppose that in some cases the origin of the deformity must be traced beyond any mechanical cause, that it is produced possibly from atypical morphological conditions which can be transmitted from one generation to the other. In the majority of cases, however, the mechanical origin is as yet the most plausible explanation, and the one which appears to throw most light on the anatomical as well as on the clinical aspects of the disease.

[1] Presented with moving picture film before Clinical Congress of American College of Surgeons, Philadelphia, October 26, 1925.

This point of view further seems to conform with the somewhat anthropological theory of Le Demany, according to whom the pathogenesis of dislocation is simply the static and mechanical result of a misplacement from an anthropological transformation of the pelvis. According to the theory of mechanical pathogenesis we must consider congenital dislocation of the hip as the result of chronic trauma to which the lower limbs, and consequently the hip joints of the fetus, are exposed in the second half of prenatal life. The flexion and external rotation of the lower limbs of the fetus, the lack of proportion which physiologically exists between the femoral head and the socket, the softness of the border of the socket, the physiological anteversion of the neck of the femur, are all favorable conditions for an incipient dislocation, which would manifest itself only after birth when the limbs of the fetus pass from flexion to extension, and would appear more evident later when the joint has to carry the weight of the body. Personally we favor the theory of mechanical pathogenesis, but we do not believe that this theory explains every specific case. Dislocation can be the result of a number of factors, of which the mechanical one is without any doubt the most frequent if not the only cause.

DIAGNOSIS

The second question which I wish to discuss concerns the diagnosis of the dislocation. It may seem strange to you that I place special stress on this argument, because every one of you may be convinced that there is nothing new to be said about the diagnosis of congenital dislocation. Indeed, this may be true when one is about to diagnose the deformity in a child who has already begun to walk.

The typical waddling gait is a sufficient symptom to make one suspect a dislocation, and this suspicion is easily confirmed by the X-ray. But I wish to emphasize that it is of the greatest importance to recognize the dislocation as early as possible, even before the child has begun to walk. Therefore it is necessary to appreciate symptoms that are not generally known or to which no importance is given. These symptoms can be summarized as follows: If the dislocation is unilateral, the cutaneous creases of the thigh, so evident in the infant, are no longer symmetrical. On the dislocated side they are proximally displaced; the inguinal and gluteal pleats are deeper and longer than on the normal side. The outline of the dislocated hip is more prominent. The luxated limb has a tendency toward external rotation. Abduction is slightly diminished. Shortening is nearly always minimal, but appreciable to the skilled eye. If the dislocation is bilateral, there is no difference in length in the limbs, but the pelvis appears enlarged because of the projection of the trochanters, the buttocks are flattened, and the limb cannot be normally abducted.

In those countries where congenital dislocation is frequent, as for example in the northern part of Italy, it happens frequently that the deformity is suspected by the mother even before the child learns how to walk. This is partially due to the propaganda which is intensively carried on to educate parents to bring their infants who show any tendency to dislocation at the earliest possible moment and place them under the observation and care of a specialist.

I am absolutely convinced that the practice of operating on the dislocation early will bring a decisive improvement in the results.

TREATMENT

Ordinarily in the treatment of dislocation, I follow the classical method of Paci, whose technique I need not describe. For the immobilization I follow in a general way the methods of Lorenz. Differing from what is commonly done in America, I divide the immobilization periods in two stages: in the first stage the limb is held in the classical first position of Lorenz for approximately 3 months; during the second stage, that lasts from 2 to 3 months, the limb is immobilized in a minor degree of right angle abduction and in internal rotation. Great importance should be given to the physical treatment which must be undertaken when the period of immobilization ceases.

All that we have said refers to the bloodless method of treating dislocation, a method which we may say has entirely replaced the open operation which, as you remember,

was practiced before Paci taught us the method of reduction through manipulation. But open intervention has not been altogether abandoned. Some surgeons still resort to it frequently. Our experience would lead us to be very conservative in using this method. It should be used only in those cases in which the reduction cannot be obtained by the ordinary method. And we cannot deny that this is quite often the case. When the reduction is attempted in patients of an advanced age, and also in young patients in whom the primary displacements are very marked and there is a misshapen capsule or serious anteversion of the femoral neck, failure may follow the Paci treatment. Then and then only must the surgeon play his last card by attempting the open operation. We gather that this occurs on an average in 5 per cent of the cases.

The technique which I use in the open operation is as follows: A straight incision is made beginning about 2 inches above the anterosuperior spine of the ilium and carried along the crest down to and beyond the anterior superior spine. The muscles, rectus femoris, and tensor fascia femoris are separated and well retracted by blunt dissection. The capsule is exposed. An incision is made through the capsule. Special retractors are used to expose the head of the femur to full view. The capsule is examined for constrictions. The capsule is usually shaped like a funnel and this occasionally prevents reduction. A special instrument in the form of a dilator is inserted through this narrow constricting portion of the capsule and the capsule forcibly dilated. A special instrument in the form of a skid, similar to that of a Murphy skid, is introduced into the dilated portion of the capsule and into the normal acetabular cavity. The knee is grasped and the femoral head abducted and inverted over the sliding instrument into the acetabular cavity. The wound is closed in the usual manner without drainage. Dressings are applied and the thigh is placed in right angle abduction and slight internal rotation similar to that used in the closed method.

I have so far discussed the treatment of dislocation in patients who are within the age limit which experience has taught us to be the best for obtaining favorable results, that is, for bilateral dislocation a maximum age of 4 years, and for single dislocations a maximum of 7 years.

What shall the surgeon do when he is confronted with a case in which the age limit is passed? It is hardly possible to give a definite answer to this question. There are cases in which the patient's age excludes the possibility of obtaining a perfect functional and anatomic recovery, but in which intervention cannot be avoided. In other cases the surgeon must advise against intervention. The surgeon must judge not on the actual state of the dislocation, but must be lead, in advising, to consider the future of the patient and the complications which may eventually arise from the existing deformity. There is a danger which usually becomes manifest only after the fifteenth or the twentieth year; that is, traumatic arthritis which is the cause of pain, rigidity, stiffness, and consequently, functional impediment. If these symptoms appear early, that is, before the fifteenth year of age, they are sufficient cause for operation. Even if ankylosis results, this is sometimes preferable to a painful dislocation.

Once intervention has been decided on, one has the choice between the bloodless method, the open reduction, and the other palliative operations such as the anterior transposition, subtrochanteric osteotomy, or the bifurcation of Lorenz. In suitable cases we have succeeded in obtaining reductions by manipulation, even in patients of 20 and 21 years of age. Open intervention must always be considered as a serious operation to be resorted to only in certain well defined cases.

In four cases, I performed a real arthroplasty of the hip, modeling in a suitable manner the femoral epiphysis, deepening with an electric drill the cotyloid cavity and interposing a flap of fascia lata.

Among the palliative methods, which can be suitably employed, we have the anterior transposition and the so-called bifurcation operation of Lorenz, that is an intervention destined to place a stump of the diaphysis instead of the femoral head into the acetabular cavity.

RESULTS

And now before closing let me say a few words as to the results.

The improvement in technique, which is the result of increased experience, and the belief that we must treat dislocations at the earliest possible age are the principal factors in our improved statistical data. Our statistics for the year 1913, which include only 700 cases, show an average of functional and anatomical success around 80 per cent for single dislocations, and 60 per cent for bilateral. On the basis of 1,879 cases with 2,556 reductions, we may say that we have succeeded in 90 per cent of the single dislocations and we have improved 65 per cent of the bilateral cases. By this I do not mean to say that the remaining cases are entire failures. Anterior transposition may sometimes (particularly in bilateral dislocations) produce results which are functionally just as satisfactory as those which are anatomically perfect. We must not forget that modern technique has taught us how to avoid the greater number of those incidents which are apt to produce the greatest damage in unsuccessful treatment, such as fracture of the femoral neck and the paralysis of periarticular nerves.

We are further convinced that the treatment of dislocation of the hip will in the future show results which will increase our present figures as regards successful cases. This will be easily accomplished when it becomes generally possible to begin the treatment at an earlier age than is now the case.

I have endeavored to outline the principal facts which should be known regarding a deformity, a study of which is one of the most interesting chapters in the history of orthopedic surgery. I do not presume to have been able to give you a clear vision of this vast problem, but even had I spoken at greater length I would probably not have succeeded in making the facts clearer. In discussing these subjects, words are of little value if not accompanied by practical demonstrations.

SECONDARY OPERATIONS ON THE COMMON BILE DUCT

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DURING the last few years, noteworthy advances have been made in the treatment of complicated disturbances of the biliary tract. These have consisted of studies of the blood and clinical methods of examinations that have indexed the patient's condition so that the most opportune time for operation and the extent of safe operative procedures can be accurately determined. Rehabilitation of the patient with obstructive jaundice by means of intravenous injections of calcium chloride and glucose solutions, before and after operation, has been of value in this respect.

The van den Bergh test enables one to determine the quantity of bile pigment circulating in the blood serum from day to day, the surgical significance of which is in the opportunity thus afforded of delaying operative measures when the bile retention is increasing, because of the risk of postoperative bleeding or hepatic dysfunction.

The fact that removal of the dog's liver, as shown by Mann, is accompanied among other changes, by such a decrease in the amount of blood sugar that tetanic convulsions ensue, and the fact that the convulsions cease immediately after the intravenous injection of glucose solution have led to the use of intravenous injections of the glucose solution in many patients with disturbance of the liver.

In 1909, Abel and Rowntree demonstrated that halogenated phenolphthalein (phenoltetrachlorphthalein) was excreted totally in the bile. Based on this fact, Graham, using the sodium salt of other halogenated phenolphthaleins (tetrabromphenolphthalein and tetra-iodophenolphthalein), has shown that the bile in the gall bladder becomes opaque to the roentgen ray after their oral and intravenous administration. The use of this method of cholecystography and the proper interpretation of findings have greatly increased the accuracy of the roentgenographic diagnosis of gall-bladder dysfunction. The practical application of these principles has made it possible to extend operability to include many patients with complicated disease of the biliary tract who in earlier years would have been denied operation because of the grave risk entailed.

SECONDARY OPERATIONS ON THE COMMON BILE DUCT

From the standpoint of diagnosis and treatment of disease of the biliary tract, involvement of the common bile duct often causes unsuspected postoperative complications. In some instances, therefore, a satisfactory operation may be performed on the gall bladder, and the disease of the common bile duct may be overlooked either as a result of failure to recognize the cardinal signs and symptoms of disease of the duct, or of failure to explore it properly. Yet the technique employed in operating on the common and hepatic bile ducts is not difficult, after the common duct has been identified. Such cases of common duct disease are not infrequently overlooked at operation. For instance, during the last 6 months I have performed secondary operations for disease of the common bile duct in 6 cases in which symptoms prior to the first operation were characteristic of involvement of the common bile duct. A summary of these is appended. Although careful attention had been given at the previous operations to the treatment of the diseased gall bladder, the existence of a stone in the common duct had not been discovered. In Cases 1 and 2, the stones were large enough to be felt on palpation of the duct, and accessible enough to be removed by simply cutting down on them (Fig. 1.)

Included with the present series of cases, in which secondary operations on the biliary tract were necessary, are short abstracts of 7 other cases of common duct involvement, in which I operated during the same period. Each case is illustrative of a different group in which obstructive jaundice is a complicating factor of biliary tract disease.

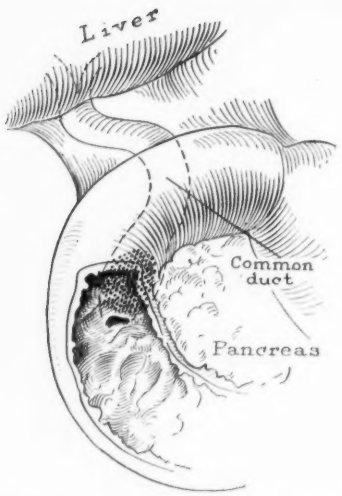

Fig. 1. (Case 1.) Stone, 3 by 2 centimeters, in the common duct just above the papilla.

THE ABSENCE OF JAUNDICE

In 30 per cent of the chronic cases in which a stone is present in the common bile duct, there may be no jaundice at the time of operation, because of the fact that a movable stone in the common duct may not produce jaundice until it becomes fixed. Fenger was the first to explain and demonstrate a "ball-valve stone." The history and operative findings in Case 3 are quite characteristic of such a condition. Again there may be a number of stones in the common bile duct and little or no jaundice until the distal stone becomes impacted in the duct, after which there is obstruction and jaundice. Recently I operated on a patient (Case 8) whose only attack of jaundice had followed a gall-stone colic 12 years previously. She had had frequent gall-stone colics since that time, but no jaundice. At operation three stones were removed from the common duct and two from the hepatic ducts. Palpation of the duct revealed their presence. The absence of jaundice in the presence of one or more stones in the common bile duct can sometimes be explained by the resiliency in the wall of the duct, probably because there is little secondary infection.

Charcot's syndrome, consisting of chilly sensations and fever, is quite indicative of involvement of the common bile duct in a patient who complains of upper abdominal pains either before or during such febrile attacks, provided the renal factor has been eliminated (Case 1).

THE PRESENCE OF JAUNDICE

Most patients with stones in the common duct have jaundice at one time or another following an attack of abdominal pain, of which Case 9 is a typical example. Jaundice resulting from a stone in the common bile duct will usually diminish in intensity with the lapse of time. When the skin has become bile-tinged as a result of the biliary obstruction, it is often difficult to determine when the obstruction has subsided. The van den Bergh test makes it possible to estimate accurately the amount of bile pigment circulating in the blood serum from day to day.

Operation should be delayed when the bile in the blood serum is increasing. Sometimes this rule is followed with difficulty, and yet experience has shown that an operation at such a time is performed with great risk, even though the biliary obstruction is successfully

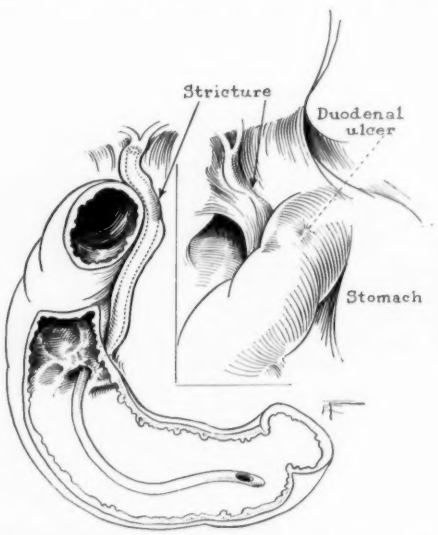

Fig. 2. (Case 4.) Reconstruction of a common duct over a McArthur catheter.

relieved. But if the jaundice is decreasing, the patient withstands the operation almost as well as though it had not existed.

PAINLESS JAUNDICE

In a few cases (more often in men than in women) painless jaundice may exist as a result of a single stone in the common duct, although it is usually the result of pancreatic obstruction, due either to malignant or inflammatory changes compressing the pancreatic portion of the common bile duct, or to carcinoma of the duct itself (Case 10). Should the jaundice be the result of a common duct stone, a period of observation prior to operation may allow the jaundice to decrease and also permit the development of additional symptoms to clarify the diagnosis. This principle is well illustrated in Case 7, in which there was probably an obstructing stone in the common bile duct with no symptoms other than the jaundice. While the patient was under observation, he developed his first attack of gall-stone colic and undoubtedly passed the common duct stone, for subsequently the jaundice began to diminish. A gangrenous gall bladder, an impacted gall stone in the cystic duct, and a dilated, thickened common bile duct were found at operation (Fig. 7). In Case 13 painless jaundice had existed for months before an attack of gall-stone colic occurred, and at operation a mass of soft, putty-like, stony material impacted in the ampulla and a gall bladder filled with stones were removed. Stones formed in the common duct, after the gall bladder has been removed, are usually soft, granular, or putty-like, and contain little or no cholesterin.

Fig. 3. (Case 4.) Roentgenogram 3 weeks after operation, showing catheter in place.

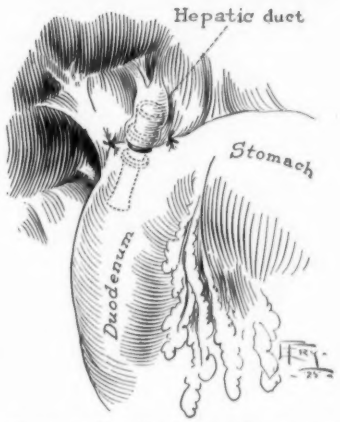

Fig. 4. (Case 5.) Hepaticoduodenostomy over a tube.

PAIN RESULTING FROM OBSTRUCTION OF THE BILIARY TRACT

The persistence of gall-stone colic, after the removal of the gall bladder, is suggestive of stones in the common or hepatic ducts. In Case 12 cholecystectomy was performed for empyema of the gall bladder in September, 1919. At that time the common duct was opened and explored because of jaundice but no obstruction or stone was encountered. An enlarged spleen was noted. In August, 1925, the gall-stone colics returned with an increase in the jaundice. A mass of putty-like material, approximately 1.5 centimeters in diameter, was removed from the lower end of the common duct and splenectomy performed at the same time for the complicating hæmolytic jaundice. The patient made a good recovery and the jaundice disappeared.

In some instances, a postoperative incomplete stricture of the common bile duct will cause attacks of upper abdominal colic simulating that which results from an obstructing

Fig. 5. (Case 5.) Roentgenogram 3 weeks after operation showing tube in place.

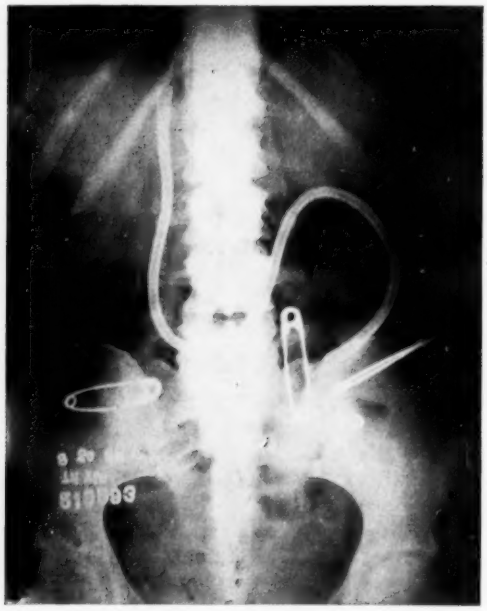

Fig. 6. (Case 6.) Roentgenogram showing catheter in place.

stone (Cases 4 and 6, Figs. 2, 3, and 6). In a few cases in which operation had been performed, dense adhesions formed around the duct, compressing it sufficiently to produce intermittent obstruction.

THE SIZE OF THE DUCT

The normal common bile duct is approximately 7.5 centimeters in length and from 5 to 7 millimeters in diameter and appears bluish from contained bile. When it is affected either by infection or by obstructing stone, its walls become thickened, the color changes to yellowish white, and the caliber is noticeably increased. These changes are indications for exploration of the duct, even in the absence of jaundice or other symptoms of common duct disease.

In secondary operations on the common bile duct, the relationship of the common duct, the hepatic artery and the portal vein may be distorted as the result of the formation of scar tissue, and if there is doubt as to the position of the duct, a hypodermic syringe, with the needle as an aspirator, is of great assistance in identifying it. Should the portal vein be mistaken for the common bile duct, a needle puncture is of no consequence and bleeding can be controlled easily. The aspirating needle must be of sufficient caliber to permit the free entrance into the syringe of bile thickened by disease; otherwise as a result of frequent needle punctures through the common duct, there may be bleeding into its interior, and blood instead of bile will be aspirated with the erroneous conclusion that the portal vein has been punctured.

REMOVAL OF STONES FROM THE DUCTS

Stones in the hepatic ducts, unless firmly impacted, often wash down with the first rush of bile into the common duct when the latter is incised. A delay of a minute or two after the incision is made gives time for such stones to appear. Stones only slightly impacted in the hepatic ducts can usually be removed with a common duct scoop; if not,

they may sometimes be brought down by inserting the little finger into the proximal end of the bile duct through the exploratory opening, the finger being used as a piston to suck the stones into view. Courvoisier called attention to the ease of removing a stone in the middle portion of the common bile duct by grasping the duct and stone in the left hand and cutting directly down on the stone, as one would on a darning ball in a stocking. Bartlett's common duct retractor is often useful. Stones in the lower portion of the common duct may be worked by the thumb and forefinger of the left hand into the upper portion of the duct and removed through the incision. If such stones are impacted, a pair of Desjardin forceps introduced into the duct makes it possible in most cases to grasp and remove the stone easily through the exploratory incision in the duct.

Obstruction in the lower end of the common bile duct may be due either to a stone or to abnormal changes in the head of the pancreas. If a probe or scoop cannot be passed through the lower end of the common bile duct into the duodenum, the reason for this failure must be ascertained, even if it necessitates making a transduodenal exposure of the ampulla (9, 17). This procedure was used to advantage in the removal of a coincidental duodenal ulcer (Case 4, Figs. 2 and 3) and greatly assisted in removing all of the stony material impacted in the ampulla in Case 13. The importance of determining the presence of all obstruction in the biliary tract, and removing it if possible, cannot be too strongly emphasized; it has been found that in 50 per cent of patients who die following operation for common duct stone a stone has been overlooked in the biliary tract.

Sometimes a small stone at or near the papilla will be pushed ahead of the scoop into the duodenum, freeing the duct. The scoop for clearing the duct must be used without too much force, as otherwise the stone may slip to one side into a traumatic diverticulum permitting the scoop to slip by the stone into the duodenum and thus lead to the erroneous belief that the duct is free from stones. There is no probe like the finger and when the duct is sufficiently dilated to admit the finger, the discovery of a stone is facilitated greatly. If the head of the pancreas is enlarged, it may be very difficult to be certain that stones are not overlooked.

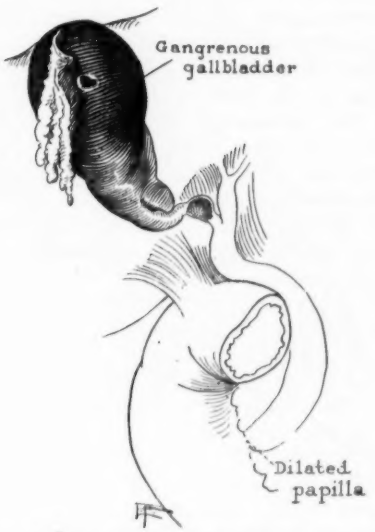

Fig. 7. (Case 7.) Stone in cystic duct. Note gangrenous gall bladder, enlarged common duct, and dilated papilla.

STRICTURES OF THE COMMON BILE DUCT

Most strictures of the common bile duct are the result of injury to the duct or of infection following previous operations (Case 12). It is true that congenital stricture of the common duct is a possibility, although it is extremely rare, and also that stricture may occur as a result of typhoidal ulceration, syphilis, or an extensive duodenal ulcer. If, in removing a gall bladder, one is always careful to expose and isolate the cystic duct at its union with the gall bladder, there is little, if any, chance of injuring the common or hepatic ducts. Similarly, the same attention to the cystic artery is advisable, for the retraction of this artery during an operation on the gall bladder and the hasty attempt to catch it with sharp-toothed forceps is often the cause of injury to the biliary ducts.

Not only is the surgical treatment of stricture of the common duct tedious and difficult, but the end-results in many instances are not satisfactory. In the repair of a stricture of

the common or hepatic ducts the essential factor is the replacement of the affected tissue by tissue immune to the irritating effects of bile, so as to prevent secondary strictures from the contraction of fibrous tissue, as shown by Horsley.

There are two methods of reconstructing the common bile duct for stricture. The first method is direct implantation of the duct or portion of the duct into the duodenum, as performed by W. J. Mayo in 1905. Because of the union of mucous membrane to mucous membrane this operation is not marred by postoperative contracture of fibrous tissue, and has given excellent lasting results. Such a procedure was used in Case 5, the stump of the hepatic duct being anastomosed to the duodenum over a short piece of catheter, and cuffed to maintain it in position until union occurred at the anastomosis (Figs. 4 and 5). Walton, in 1915, modified the operation by using a flap of duodenal tissue as a tube, and connecting the cut end of the hepatic duct to the duodenum, anastomosis being made over a portion of a rubber tube.

The second method, indirect implantation, depends on the use of a rubber tube or similar structure to fill the gap between the cut ends of the ducts and the intestine. Sullivan, who called attention to this method in 1900, suggested using a tube or piece of catheter to bridge the gap between the stump of hepatic duct and the duodenum, covering the bridge with omentum and surrounding structures.

Propping advocated the use of a T tube to assist in the reconstruction of the common duct for stricture, the upper shorter end of the tube being placed in the hepatic duct, the lower end extending through the lower end of the duct into the duodenum with the perpendicular limb of the tube coming out through the abdomen. Although the T tube is still used in the plastic repair of such strictures, the results following its removal have not been altogether satisfactory; in some cases scar forms at the opening made in the duct for removal of the tube.

In cases of small stricture in the center of the common duct, the stricture can be divided and a plastic repair made, by using McArthur's method of inserting a catheter, its bell end being cuffed and placed in the hepatic duct and the catheter itself extending through the common duct down into the lumen of the duodenum through the ampulla of Vater (Cases 4 and 6, Figs. 2, 3 and 6). The catheter establishes the continuity of the biliary tract, and at the same time provides the scaffolding for plastic repair of the stricture. The tube can be maintained in place by catgut suture or by means of a silk thread passed through it, brought out through the abdominal wound and fastened to the abdomen with adhesive. The silk thread is removed and the tug of intestinal peristalsis carries the tube out of the duct and through the intestines at the required time.

Another method of indirect implantation is the anastomosis of the fistulous biliary tract to the gastro-intestinal tract. This operation was first performed by von Stubenrauch and failed. Later Murphy anastomosed the end of a fistulous biliary tract to the exposed lower end of a common bile duct, and recently Lahey has reported two successful cases in which the fistulous biliary tract was transplanted into the duodenum.

In a very small group of cases, in which operations on the biliary tract have been performed, the attacks of pain and a retention type of vomiting similar to that of pyloric spasm persist. Exploration of the common duct in such cases may not reveal gross cause for the obstructive manifestations, and yet when one passes an olive-tipped probe through the lower portion of the common bile duct, there is a distinct tug felt as it enters the ampulla, and again as it goes through the sphincter of Oddi into the duodenum (Case 11). The same tugs are again experienced on the withdrawal of the probe, so that this might be considered a possible cause of an intermittent obstruction in the common duct in the absence of other obstruction. Mechanical dilatation usually results in a subsidence of the symptoms.

PANCREATIC OBSTRUCTION

Obstruction of the pancreatic portion of the common duct may be a result of primary inflammation, or it may be secondary to inflammatory conditions in the biliary tract, or to a

malignant condition at the head of the pancreas. Deaver believes that the symptons of pancreatitis may simulate those most typical of a common duct stone. Helly, in a study of the relation of the pancreatic portion of the common bile duct to the pancreas, showed that in 25 of 40 cases the duct passed through the substance of the gland, while in the remaining 15 cases it was not entirely surrounded by pancreatic tissue. We may be assured then, that if pancreatitis is associated, more than 60 per cent of patients will be jaundiced.

Moynihan has called attention to the fact that when jaundice is the result of pancreatic malignancy, rigor and intermittent fever are usually absent. No variation occurs in the jaundice and often there is intense steady pain in the back. In many cases it is very difficult to distinguish between these two conditions, even at operation, and for this reason, whenever the general condition of the patient permits, an anastomosis is made between the gall bladder and the gastro-intestinal tract. Such was the condition in Case 10. A history of intermittent fever and jaundice for almost 2 years was sufficient reason, after the demonstration of a tumor at the head of the pancreas, for cholecystogastrostomy. The patient withstood the operation with little reaction and was dismissed from observation 4 weeks later free from fever and jaundice, and gaining in weight. The pancreatic tumor may have been the result of inflammatory pancreatitis or secondary to a slow growing pancreatic carcinoma. The operation will benefit the patient in either event, by relieving the obstruction in the biliary tract and adding considerable comfort to his existence. Should the obstruction be the result of pancreatitis, the patient will recover and remain well.

POSTOPERATIVE TREATMENT

Usually patients convalesce uneventfully when operated on after preliminary preparation, consisting of intravenous injections of 5 cubic centimeters of 10 per cent calcium chloride solution, adequate fluids and abundant carbohydrates, especially glucose. Should the patient fail to convalesce satisfactorily, the blood is studied. Should the acid-alkali balance be disturbed, intravenous injections of sodium bicarbonate are given to control acidosis or sodium chloride to control alkalosis. These are usually added to a solution of 10 per cent glucose. The stomach tube is used if there is gastric retention, which is usually evidenced by hiccup, or persistent vomiting of small amounts. Should bleeding occur following the operation, the intravenous injections of calcium chloride are resumed, and a blood transfusion performed if necessary.

REPORT OF CASES

CASE 1. A woman, aged 45, had had gall-stone colics, and was jaundiced in November, 1923. In May, 1924, cholecystostomy was performed elsewhere, but no stones were found in the gall bladder. The biliary fistula closed in 6 weeks, but the jaundice did not diminish. The patient continued having pain in the right upper quadrant and also between the shoulder blades. At times she had had chills and fever.

Examination revealed jaundice 3 and serum bilirubin 8.9 milligrams for each 100 cubic centimeters. A diagnosis was made of stone in the common duct. At operation (choledochostomy), a stone, 3 by 2 centimeters was found in the common duct just above the papilla and removed. The patient made a good recovery (Fig. 1).

CASE 2. A woman, aged 61, had had cholecystostomy for gall stones, appendectomy in September, 1923, elsewhere, and cholecystectomy for gallstones in July, 1924, elsewhere. She continued to have attacks of gall stone colic with jaundice.

Examination revealed jaundice 2 and serum bilirubin 3 milligrams. A diagnosis of stone in the common duct was made, and at operation a stone, 1 centimeter in diameter, was found in the lower end of the common duct and removed. The patient recovered uneventfully.

CASE 3. A woman, aged 59, had had two previous operations elsewhere on the gall bladder; cholecystostomy in 1917, and drainage of an abscess in 1921. Since the fall of 1924, she had had five attacks of pain in the upper right quadrant of the abdomen, accompanied by chilliness and cold sweats. Jaundice occasionally followed pain, when the stools were light in color.

Examination disclosed tenderness in the epigastrium but no jaundice. The diagnosis was recurring cholecystitis and probable ball-valve stone in the common duct. Choledochostomy and cholecystectomy were performed and the ball-valve stone was removed from the common duct. The stone was about 8 millimeters in diameter and situated in the ampulla at the lower end of the common duct. Chronic cholecystitis was confirmed at operation but no stones were found in the gall bladder. The patient recovered and has been free from symptoms since.

CASE 4. A woman, aged 34, had had cholecystectomy elsewhere in 1919 without relief from symptoms. During the last 2 years she had had 8 attacks of colic requiring morphine. Pain had been continuous in the upper abdomen for the last 5 months. Four weeks before examination jaundice appeared.

Examination revealed jaundice 3 and bilirubin (van den Bergh test) 9 milligrams July 16, 1925, and 2.8 milligrams July 25. Test of hepatic function showed phenoltetrachlorphthalein retention 4. At operation stricture of the middle third of the common duct and duodenal ulcer were discovered. Reconstruction of the strictured duct over a McArthur catheter with excision of the duodenal ulcer and gastroduodenostomy were followed by recovery of the patient (Figs. 2 and 3).

CASE 5. A woman, aged 64, had had cholecystectomy elsewhere for gall stones in December, 1923. Two large stones were found in the gall bladder. A biliary fistula and jaundice had existed since the operation. At exploration elsewhere in April, 1924, a stricture of the common duct was found but nothing was done.

Examination showed a draining biliary fistula and jaundice 2. A diagnosis was made of obstruction of the common duct and biliary fistula. At operation a stricture throughout the entire length of the common duct to the level of the liver was found and hepaticoduodenostomy was performed, the hepatic duct being sutured to an opening made in the duodenum over a piece of catheter. The patient recovered (Figs. 4 and 5), and the jaundice subsided. She has recently had a temporary return of the jaundice lasting a few days, probably because of a temporary blockage of the tube.

CASE 6. A woman, aged 41, had had cholecystostomy elsewhere with removal of many gall stones in February, 1924. In March, 1925, she had pain in the upper abdomen, followed by jaundice for 2 or 3 days. A second attack occurred a week later, and thereafter one occurred every 3 or 4 days. Morphine was required at times to relieve the pain.

Examination revealed slight jaundice. A diagnosis was made of recurring cholecystitis with stone in the common duct. At operation a stricture of the common duct, 1 centimeter in length, in the region of the cystic duct was found. The gall bladder was about 1.5 centimeters in diameter and did not contain stones. The stricture was cut and a reconstruction of the common duct was made over a McArthur catheter, the lower end extending through the duct into the duodenum and the upper into the hepatic duct. The patient made a satisfactory recovery and has had no further colics or jaundice (Fig. 6).

CASE 7. A man, aged 65, had had gastric fullness 2 hours after meals for 2 years. Painless jaundice had begun in April, 1924. He had lost 20 pounds and also much strength. Because of his poor general condition with the history of a painless jaundice it was decided to keep him under observation for a time before making a definite diagnosis.

The patient returned to the clinic June 24, 1925, on account of an attack of excruciating pain in the region of the gall bladder which had lasted for 1 week. Jaundice had decreased in intensity since then. A diagnosis of cholecystitis and stone in the common duct was made, and at operation a gangrenous gall bladder, an impacted stone in the cystic duct, enlargement of the common duct and dilatation of the ampulla were found. The gall bladder was perforated but the perforation was protected by omentum. A cholecystectomy and choledochostomy were performed. The patient recovered from the operation and has remained well (Fig. 7).

CASE 8. A woman, aged 46, had had gall-stone colics for 21 years. Ten years previously, following a colic, she had had slight jaundice which disappeared. Although she had frequent colics during the last 10 years, there was no evidence of jaundice. In the latter part of July, 1925, she had had a similar attack of colic accompanied by fever of 102 degrees, but no jaundice.

A diagnosis was made of chronic cholecystitis with cholelithiasis. At operation several stones were found in the common and hepatic ducts, and removed. The gall bladder containing stones was removed. The patient recovered uneventfully.

CASE 9. A woman, aged 37, had had gall-stone colics requiring morphine since July, 1923, with indigestion between attacks. Jaundice appeared in May, 1925, following a severe attack of gall-stone colic. The colic recurred in September, and the jaundice increased in intensity. A dull aching pain in the region of the gall bladder had continued.

Examination revealed jaundice 4, serum bilirubin 7.9 milligrams, and a coagulation time of 12 minutes. A diagnosis was made of biliary obstruction resulting from gall stones. At operation a subacutely inflamed gall bladder was found. It contained several stones, two of which had perforated posteriorly into the liver forming two pockets communicating with the lumen of the gall bladder. A single stone approximately 1.5 centimeters in diameter was removed from the common duct. Stones were removed from the gall bladder, and drainage instituted. Good recovery followed.

CASE 10. A man, aged 50, had had intermittent attacks of painless jaundice, with light-colored stools, between July, 1923, and November, 1925. Jaundice lasted for 2 or 3 weeks, sometimes accompanied by fever; then both would subside.

In July, 1923, examination revealed a palpable gall bladder. The patient returned for observation in October, 1924, with history of recurrence of the jaundice 3 weeks previously. The distended gall bladder was still palpable. In November, 1925, he returned for examination stating that the last attack of jaundice had been present for 2 months, with loss of weight, and fever varying from 99 to 101 degrees daily.

Examination revealed jaundice 2, temperature 100.5 degrees, and a distended gall bladder. Be-

cause of the intermittent character of the jaundice and fever and the long period of time elapsing since its onset, exploration of the biliary tract and pancreas was advised. A mass was found at the head of the pancreas producing distention of the biliary tract. An anastomosis was made between the gall bladder and the stomach (cholecystogastrostomy). The patient withstood the operation satisfactorily and a month later his jaundice had disappeared; he had regained his appetite and was regaining his strength. It was difficult to tell from the consistency and contour of the mass at the head of the pancreas whether it was due to pancreatitis or malignancy.

CASE 11. A Syrian woman, aged 40, had had a history of pain in the area of the gall bladder for 10 years. Cholecystectomy with removal of four stones was performed in August, 1924, elsewhere. Four months later the dull steady pain again appeared, with attacks of colic, sometimes accompanied by jaundice. The pain was under the right costal margin, and at times extended around the ribs to the back.

At the time of examination the attacks occurred every 2 or 3 days, at times with nausea and vomiting. The van den Bergh test for bilirubin in the blood showed 0.7 milligrams in 100 cubic centimeters. Exploration of the common and hepatic ducts and pancreas was performed December 17, 1925. There were slight adhesions, and the common duct was enlarged, even more than it should be after the removal of the gall bladder. It was difficult to pass a scoop through the common duct at first, but finally a large scoop was passed. The adhesions around the duct were separated and a small drain was inserted in the hepatic duct. The patient left the hospital in good condition.

CASE 12. A man, aged 51, had had a cholecystectomy and an exploratory choledochotomy for subacute empyema of the gall bladder with gall stones in September, 1919. He was slightly jaundiced, but no obstruction was found in the common bile duct. It was noted that the spleen was twice its normal size, and there was some cirrhosis of the liver. The tinge of jaundice continued after the first operation and his general health was only fair. In the first week of August, 1925, he had another attack of gallstone colic, severe enough to require morphine with a slight increase in the jaundice and with clay-colored stools.

On examination there was slight tenderness over the right upper quadrant, and 0.5 milligram of serum bilirubin in 100 cubic centimeters of blood. The history of familial jaundice and the presence of a tinge of jaundice, practically since birth, with secondary anæmia and reduced erythrocytes led us to believe that a hæmolytic jaundice was associated with biliary tract disease. At operation a large common duct stone was found and a mass of putty-like material was removed from the lower end of the common bile duct. Because of the enlargement in the spleen and the history suggestive of hæmolytic jaundice, it was thought advisable to perform splenectomy. The patient recovered satisfactorily from the operation, the jaundice disappeared, and he was dismissed in excellent condition.

CASE 13. A woman, aged 52, complained of general weakness with loss of strength, followed by painless jaundice. A month later a sharp attack of pain occurred in the right upper quadrant, radiating to the epigastrium and around to the back. The pain was severe enough to require morphine. Since then a dull aching had persisted in the right upper quadrant. Occasionally she had had diarrhœa and light-colored stools, with bloating, and gas eructation after meals. She had lost 25 pounds in the last 6 months.

On examination the patient was found to be jaundiced 2, and tender in the right upper quadrant of the abdomen. A diagnosis of common duct obstruction was made with a 50 per cent chance of a malignancy. At operation a distended gall bladder and common duct were found. Impacted in the ampulla was a mass of putty-like, stony material, approximately 1.5 centimeters in diameter. It was so firmly fixed that a trans-duodenal exposure at the papilla and an opening in the common duct were necessary in order to remove all the fragments of stone. The gall bladder was filled with stones and thick, caramel-colored bile. The gall bladder was removed and a catheter placed in the common duct. The opening in the duodenum was sutured. The pancreas was apparently normal and there were no other stones in the hepatic duct. The patient's convalescence was satisfactory until the ninth day when, following the removal of a gauze drain, a hæmorrhage occurred from the drainage tract. This ceased during the next 12 hours. Three days after the first hæmorrhage, a second occurred which necessitated blood transfusion and packing of the operative area with gauze.

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THE USE OF RADIUM AND X-RAYS IN THE TREATMENT OF MALIGNANT DISEASES OF THE PARANASAL SINUSES[1]

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ACCURACY in details is essential to proper application of radium and X-rays in the treatment of malignant diseases. The histological structure of the tumor, its size and shape, its relation to adjacent structures, particularly bone, and the presence or absence of infection must all be considered.

Probably no location in the body presents so many complicating factors as the paranasal sinuses. A wide range of tumor type is possible. The primary site of origin is often difficult and frequently impossible to determine. The invasion of adjacent soft parts, bone and cartilage, and sinuses is hard to define. Interference with sinus drainage and infection gives rise to inflammatory tissue which it is often impossible to differentiate clinically from tumor tissue.

The peculiar anatomy of the paranasal sinuses favors inflammatory processes. Just how much this has to do with the original cause of many of the growths is not known. Certainly it is an important factor. Inflammatory processes alter the normal type of tumor growth and influence unfavorably the protective cellular reactions in surrounding normal tissues.

The complex embryology of the parts under discussion affords opportunity for tumor origin from many developmental anomalies. Hence a wide range of tumor type is met with.

Inasmuch as malignant growths of the maxillary antrum predominate, it is perhaps best, for the purposes of the present discussion, to center around this group. Whether most of the tumors referred to as antrum growths are primary or are secondary extensions from other sinuses or the nasal passages is frequently not understood. Inflammatory processes often mask the true picture. In our own experience these cases are usually so far advanced that the exact site of origin cannot be determined with any degree of accuracy.

Carcinoma is the predominating type of growth. A cylindrical cell carcinoma of adenocarcinomatous structure is most com-

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mon in all of the sinuses. It is rapid in growth, bulky, and bleeds easily. It invades bone readily or may erode it from pressure. Consequently, with this type of tumor in both antrum and nasal passage it is impossible to determine the primary origin. Squamous-cell carcinoma usually represents secondary invasion of the antrum but may arise there primarily from lining membrane cells altered, or flattened, by some previous inflammatory processes.

Certain basal-cell tumors arise in the antrum, adenoid cystic epithelioma, cylindroma, and endothelioma. These are usually of dental origin and are easily identified by their relation to the teeth. They are altogether less malignant and of slower growth than other types but are not usually recognized until late.

Most of the so-called sarcomata of the antrum are in reality round-cell carcinomata of atypical structure, the result of chronic inflammatory changes in the lining mucous membrane.

True sarcoma of the antrum and nares is usually angiosarcoma or myosarcoma. Osteogenic sarcomata are rare but are easily recognized either radiographically or histologically.

Mixed spindle and round-cell sarcomata of the turbinates, so-called fibrosarcomata, are not uncommon. Chondromyosarcomata of the vault of the pharynx are met with occasionally in children.

Lymphosarcoma may appear at almost any point in the paranasal sinuses but is practically always only a part of a more generalized disease. It is not improbable, however, that this disease frequently has its origin in the lymphoid tissue of the postnasal space. Its invasion of the sinuses therefore is from behind forward. Its rate of growth is so rapid that the exact origin can only be guessed at.

Essentially benign tumors do not come within the scope of this paper. Mention is made simply to say that they are purely surgical problems. If radium is used, its caustic action must usually be employed and this element makes it too dangerous to be used in benign tumors.

The symptoms and clinical course of malignant diseases of the paranasal sinuses are too well known to merit discussion here, except for emphasis on one point. (I realize that I am dealing with the problem from the standpoint of one treating malignant diseases rather than as a nasal specialist. Yet, I do not believe much time elapses between the making of a diagnosis by the nasal specialist and reference to us for treatment.) The cases are almost invariably far advanced. It does seem that they are considered inflammatory for too long a period and that biopsy or earlier surgical exploration of more sinuses would result in a saving of many of these cases.

Mixed infection with the resulting inflammatory processes not only complicates diagnosis but makes definition of the tumor-bearing area uncertain. It adds to the surgical risk: It aggravates tumor growth. Osteomyelitis almost invariably accompanies tumor invasion of bone. It interferes with the reaction of the normal tissues about the growth to the physical agents. More of these cases succumb to fatal infection than to the natural progress of the disease.

A review of the literature reveals rather few favorable results in the treatment of adult types of malignant growths in the sinuses. This is not surprising when we realize that surgical principles, as applied elsewhere, can rarely be applied in the treatment of accessory sinus growths, except perhaps in excision of the upper jaw for early growths in the maxillary antrum without bone invasion.

During the past few years radium and X-rays have proven of value in dealing with this group of cases. These physical agents, however, have their drawbacks and shortcomings just as surgery has in such a complicated group of diseases.

In our experience a combination of surgery, radium, and X-rays offers most. We believe that radium and X-rays are capable of eradicating the tumor tissue if the radiation is delivered uniformly throughout the growth and in sufficient amount, depending upon its exact type. In order that this may be accomplished, it is frequently necessary to

expose the growth surgically. Still more frequently it is necessary to provide surgical drainage of the part; or, as in the antrum, to remove the bulk of tumor tissue after radiation in order that more active infection in breaking down tumor tissue may be avoided. In other words, we depend upon the physical agents to deal with the new growth directly, and surgery to provide access and drainage. If radium is to be placed accurately, the surgical exposure must be adequate. We are strongly in favor of large openings wherever possible. In exposing the antrum from below, the floor and anterior wall should be removed. Such an opening gives free access and can be readily closed later by an obturator on a dental plate. If the floor of the orbit is invaded the eye should be sacrificed promptly and free access afforded, in this way, from above. We must remember that we are dealing with a lethal disease and that conservative measures may postpone treatment in some unsuspected and inaccessible area until it is too late.

In our experience, X-rays alone are not sufficient to control the growth in the paranasal sinuses except, perhaps, in the cases of such unstable tumors as lymphosarcomata. They are, however, of very great assistance; and this is particularly true since the advent of shorter wave-length rays. We use X-rays for practically all of our external radiation. Radium is, of course, the agent for direct application to or into the growth. The exact method depends upon the individual case, but in principle it must be applied accurately and uniformly throughout the tumor and in sufficient amount to produce a maximum reaction, consistent with the viability of surrounding normal tissues.

For this purpose we have for several years employed bare tubes of radium emanation very extensively. During the past year we have found it possible to prepare in our physical laboratories gold emanation tubes scarcely larger than the "bare tubes," or glass emanation tubes. This gives us all of the advantages of bare tubes minus the beta radiation. In other words, it affords a means of burying filtered radium emanation, obtaining a prolonged intense gamma radiation and avoiding the severe inflammatory reaction due to beta rays.

We depend upon these small tubes of radium emanation buried uniformly throughout the growth for the major part of our radiation. We use them invariably in the antrum. In some other locations, such as the turbinates, it is possible and practical to insert metal needles containing either element or emanation. Since we have been able to replace unfiltered by filtered capillary emanation tubes our tendency has been more and more toward discontinuing the use of needles. The small emanation tubes can be more accurately placed. Distribution is more uniform. They stay in place exceptionally well. Inasmuch as the dose is prolonged to at least 14 days of active radiation, it can be very appreciably increased. There is ample reason to believe that the prolonged dose is more efficient than a comparable amount given over a shorter period. The trauma of introduction of capillary tubes is less than with needles.

Occasionally it is possible to place filtered tubes of larger size in rubber tubing, either singly or in tandem, and to pack them firmly in place at some point along the nasal passages.

A very efficient radiation of the postnasal space may be obtained by placing a bulb of emanation in a small hollow metal sphere as a filter, this being wrapped with gauze to lend proper distance, and drawn up into the postnasal space by means of a string previously passed backward through the nares. The type of bulb we usually employ for this is filtered by 0.4 millimeter gold-platinum alloy and is about 8 millimeters in diameter.

These special applicators, however, must be devised to suit the individual case. The only standard form of radium application which we employ is the interstitial implantation of gold capillary emanation tubes.

The internal applications are almost always supplemented by external doses of X-rays or filtered radium, or both.

Radium applied within the sinuses produces an inflammatory reaction in the soft parts which increases the danger of infection. Hence adequate drainage is doubly indicated. It also has a devitalizing action on bone and

cartilage if closely approximated in large doses. Bone necrosis from this cause is much less frequent since we have eliminated unfiltered emanation, but it is still a factor.

Since the majority of the growths under consideration arise in or extend into the antrum it may be well to outline briefly our exact procedure in treating them. External radiation with both short wave-length X-rays and heavily filtered radium is applied over the antrum and adjacent parts. This produces a marked inhibition of tumor growth. We use both X-rays and radium for this because we feel that by varying the quality of radiation larger doses can be given with better clinical results. Following the external treatment, capillary gold emanation tubes are inserted directly in the tumor through its ulcerating surface or the point of bone necrosis, and left in place. If tumor tissue is present in the nasal passage it is treated likewise. From 10 to 15 tubes of 2 to 3 millicurie value are used, the number depending on the size and extent of the tumor. Ten days to a fortnight later the antrum is exposed widely by removal of its floor and anterior wall, and the tumor-bearing area cleaned out as carefully as possible. When the packing is introduced a bulb of filtered radium is put in with it at the central point of the cavity or in another location according to the local conditions which obtain. Usually a dose of 25 to 40 millicurie emanation is used for this purpose and is removed with the packing at the end of 48 hours.

If the tumor has invaded the orbit we remove the eye so that access may be had from both above and below. Such a procedure may very well be considered mutilating but in our experience has proven to be well worth while. It provides the only means of accurate radium application and, in addition, facilitates drainage. We have failed in a number of cases by attempting to apply radium through the antrum and nasal passages after growth had extended into the orbit.

The procedure which I have outlined thus far applies, of course, to the case in which we feel we have a reasonable chance to control the growth completely.

If the patient's general condition is poor, if the growth is very extensive invading the orbit, ethmoids, and possibly the sphenoid cells, or if inoperable cervical metastases are present, then nothing but palliative measures should be considered. For this, external radiation plays the greater part. Small amounts of filtered interstitial radiation may be employed at times, but always with caution.

As for the choice of method in removing the radiated tumor tissue I believe there is rather little to be said. We depend upon radium and X-rays to devitalize or destroy the growth. The only points to be considered in removing it are simplicity and a minimum of trauma. The use of scalpel and curette is bloody and necessitates too much manipulation of tissue. The old-fashioned cautery is clumsy and brings in the factor of too much heat. The same may be said of the use of soldering irons except that small ones are not as cumbersome to handle. We have found that coagulation of the entire area by means of the high-frequency cautery and removal either with curette or the high-frequency cutting needle furnishes the desired result with a minimum of trauma. It can be done very satisfactorily under local anæsthesia.

So far I have made no reference to the treatment of metastatic cervical nodes secondary to the various types of carcinoma encountered in the paranasal sinuses. For these, we follow the same procedure as has previously been outlined for metastatic nodes secondary to intra-oral carcinoma; that is, a combination of X-rays, radium, and surgery.

All necks are radiated with short wave-length X-rays. If no nodes are palpable the case is kept under careful periodic routine examination. If an enlarged movable node with presumably intact capsule is present on admission or appears later, the X-radiation is supplemented by radium packs and following this a unilateral dissection done under local anæsthesia. Radium emanation is always buried in the wound at the time of the surgical dissection. If the metastatic node has perforated its capsule and the infiltrating growth is fixed in adjacent structures we class the case as inoperable. External radiation is continued and emanation tubes implanted in the mass as a palliative procedure, but no dissection is attempted. Likewise, if the

primary growth is far advanced but with an otherwise operable neck, we treat the neck as well as the primary mass in a purely palliative manner.

If the primary growth in the sinuses is of basal-cell type no attention to the neck is necessary because the tumor does not metastasize. If the primary growth be a lymphosarcoma no surgery is indicated in the neck. It is a disease which extends widely and rapidly and as for any single local manifestation it can always be managed better by the physical agents than by surgery. As for the true sarcomata occasionally met with in the sinuses I am of the opinion that no surgery is indicated when metastases are present. They are too apt to be multiple and had best be treated by radiation.

In reviewing our clinical material relative to this subject, I have been more forcibly impressed than ever with the advanced character of practically all of the cases. The majority is classed as carcinoma of the antrum with extensive bone destruction and the nasal passage partially or totally occluded by tumor tissue. In these it is impossible to determine in which sinus the growth was primary.

Of 100 cases treated between 1916 and the present time all but 28 patients were beyond the hope of anything except palliative measures. In 7 of these 28 cases the eye was removed, and the antrum cleaned out from below. Of the total group, 56 patients are known to be dead; 22 have been lost track of and are therefore assumed to be dead; 7 cases are too recent to classify, and 15 present no clinical evidence of disease.

The duration of freedom from clinical evidence of disease in these 15 cases is as follows:

1 case 7 to 8 years,
1 case 4 to 5 years,
2 cases 3 to 4 years,
5 cases 2 to 3 years,
4 cases 1 to 2 years,
2 cases 9 to 12 months.

Of the 7 cases with removal of the eye in addition to operation through the mouth, 2 patients are well after 2 years; 1 is well after nearly 2 years; 1 was recently treated, and 3 died.

In the group of 15 cases clinically free from disease 11 were of carcinoma and 4 of sarcoma.

We have seen only 1 case of primary carcinoma of the frontal sinus. This patient is now well 6 years after surgical exposure and radiation directly within the cavity.

One very unusual case of lymphosarcoma which had extended well into the antrum and orbit has remained well nearly 7 years following external radiation, removal of contents of orbit, antrum, and ethmoids, and intensive radiation within the cavity.

CONCLUSIONS

1. Surgical exploration of the paranasal sinuses and biopsy should be resorted to earlier and more frequently so that earlier diagnosis of new-growths may be made.

2. With few exceptions, the principles applying to surgical removal of cancer in general cannot be carried out in dealing with growths in the paranasal sinuses.

3. Radium and X-rays are of value in treating this group of cases but, except in palliative procedures, must be used in conjunction with surgery.

4. Radium and X-rays may be depended upon to eradicate the tumor tissue if applied accurately and uniformly throughout the growth in sufficient dosage.

5. Surgery must be employed to provide exposure for radium application and adequate drainage.

6. The anatomical relations of the parts are such that infection is a much greater menace here than in new-growths in most other locations.

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DISCUSSION

DR. G. E. PFAHLER. The results obtained from radium and X-rays in the treatment of paranasal

sinuses would probably be less discouraging if the diagnosis could be made at an earlier stage when the disease is not so extensive and thorough and radical combination treatment could be applied. Toward earlier diagnosis I would urge that every rhinologist keep in mind the possibility of malignant disease, and when in doubt have an X-ray study made. This X-ray study should be very thorough, otherwise it may be misleading. The extent of invasion and often the extent of the associated exudative and inflammatory processes can be determined. An X-ray study will show that in malignant disease the septa and walls of the sinuses are destroyed. This destruction has a different appearance from the destruction caused by a pyogenic process. The destructive process would resemble only a very acute stage of a pyogenic process; in the acute inflammatory processes the diagnosis of malignant disease would not have to be considered. In the chronic inflammatory processes, which are the type to be compared with malignant disease, destruction of bone is associated with a defensive process on the part of the organism, indicated by sclerosis, associated increased density at the border of the destruction, and thickening of the cell walls. The opacity of the sinuses is also demonstrated, together with the erosion of the walls or pressure of the walls. If the growth is relatively benign there may be pressure and displacement effect from the growth.

If the diagnosis is still doubtful, a section should be removed for microscopical study. The operation should be an open one, with a wide opening through the face rather than through the mouth, not only for the reasons already given, but for the sake of having the drainage, which occurs in connection with the sloughing process, outward instead of in the mouth and throat. I believe that the best method of destruction is by means of the radiotherm, or electrocoagulation equipments. Especially in those cases in which there is considerable pain, I would urge that preliminary to any destructive process, the patient have a ligation of the external carotid to control hæmorrhage, and at the same time a resection of the fifth nerve. In this way the subsequent operative procedure can be carried on without an anæsthetic and practically without hæmorrhage.

I would urge, with regard to radiation, that before the operation the patient be treated by high-voltage X-rays from every angle, by cross-firing upon the disease; and that this treatment be very thorough, preferably given daily, and so controlled and measured as to do no harm but to deliver the maximum quantity into the diseased tissue.

At the time of the operation I believe that it is advisable to use filtered radium rather than radium seeds for the sake of eliminating further necrosis and of getting a more distant effect on the cells that might still be invaded by the malignant disease.

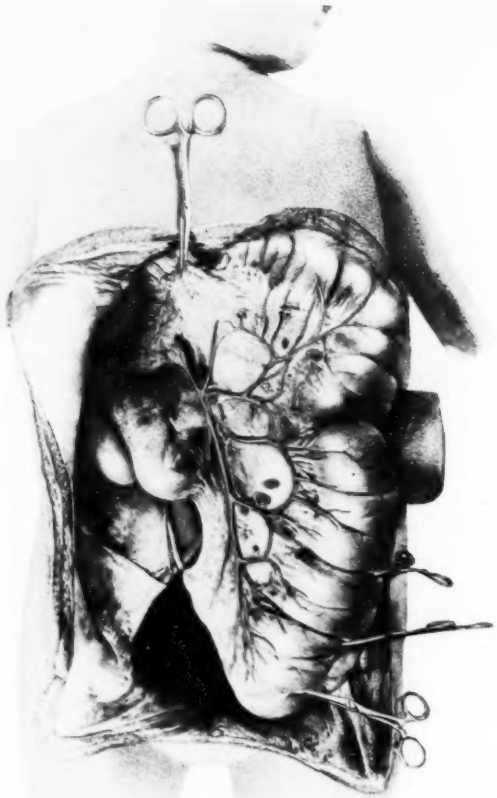

Fig. 2. Mobilization of the ascending colon. The right kidney, duodenum, inferior vena cava, ureter, and internal spermatic artery are exposed by reflection of the ascending colon toward the left side.

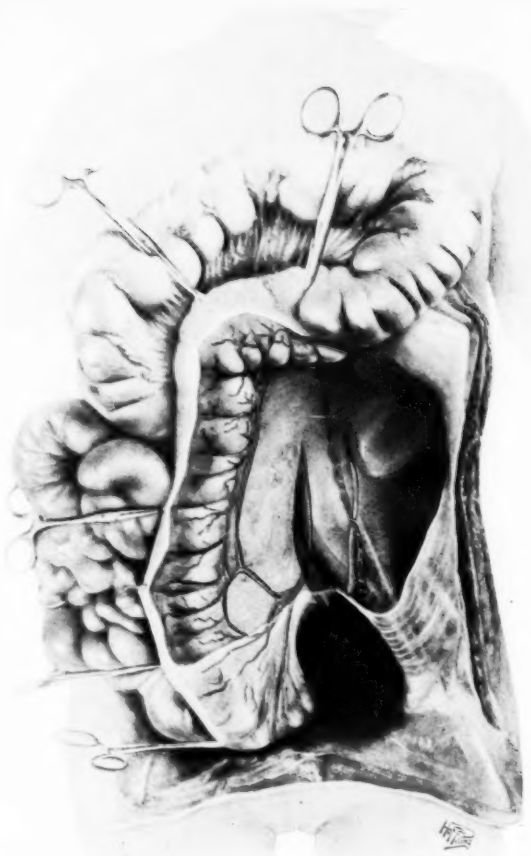

Fig. 3. Mobilization of the descending colon. The structures lying on the left posterior abdominal wall have been exposed by reflecting the descending colon and its blood supply to the right.

The Value of Peritoneal Sheets of Coalescence in Abdominal Surgery.—Alberto Gutierrez

THE VALUE OF PERITONEAL SHEETS OF COALESCENCE IN ABDOMINAL SURGERY[1]

By Dr. ALBERTO GUTIERREZ, Buenos Aires, Argentina
Clinica Quirurgica Gutierrez

THE peritoneal sheets of coalescence are remarkably serviceable in abdominal surgery. It is through them that certain fixed segments of the digestive tract may be made movable. Intestinal mobilization(the term mobilization will be used in the sense of making a portion of the gut freely movable) represents the preliminary and fundamental element in every surgical intervention on an intestinal segment that has become secondarily fixed by the process of coalescence.

EMBRYOLOGY

The primitive alimentary canal of the early embryo is a comparatively straight, simple tube occupying a mid-sagittal position. In the abdominal region the canal lies within the body cavity (cœlom) which is lined by parietal peritoneum. The visceral peritoneum is reflected from the mid-dorsal line as a double layer, the dorsal mesentery, which extends to the caudal end of the digestive canal. This is divided into the dorsal mesogastrium (which becomes the greater omentum), the mesoduodenum, the mesentery, and the mesocolon which support respectively the stomach, duodenum, small intestine, and the colon. The vessels and nerves pass within these to the canal. The spleen and pancreas are in the dorsal mesentery.

Cranially and anteriorly, there is a primitive ventral mesentery containing the liver from which the falciform ligament of the liver and the lesser omentum are derived.

The stomach undergoes a rotation on its longitudinal axis so that its anterior border (lesser curvature) is directed upward and to the right and the posterior border (greater curvature) inferiorly and to the left. The surfaces shift so as to face anteriorly and posteriorly rather than laterally. The cardiac end of the stomach and the terminal end of the gut are displaced to the left of the mid-line while the duodenum moves to the right.

The vitelline gut develops in a more complex manner. The portion of the gut destined to become the small intestine and the colon form a loop ventrally with the superior mesenteric artery as an axis directed toward the umbilicus. A rotation of 180 from left to right with the superior mesenteric artery as an axis takes place and thus the proximal limb of the loop becomes the small intestine and the distal limb the colon. This carries the caudal end of the duodenum (third part) to the left of the midline to its position in the adult. The remaining segments of the gut take their re-

Fig. 1. Mobilization of the second part of the duodenum. The great omentum is shown inferiorly and to the left. The descending portion of the duodenum is reflected to the left by separation of the retroduodenal sheet, bringing to view the right kidney and the posterior suface of reflected duodenum.

[1] Prepared for publication by Howard B. Kellogg, Department of Anatomy, Northwestern University Medical School, Chicago, Illinois.

Fig. 4. Mobilization of the ascending colon and the proximal portion of the transverse colon. The upper portion of the ascending colon and the right end of the transverse colon have been separated from the kidney, duodenum, and head of the pancreas.

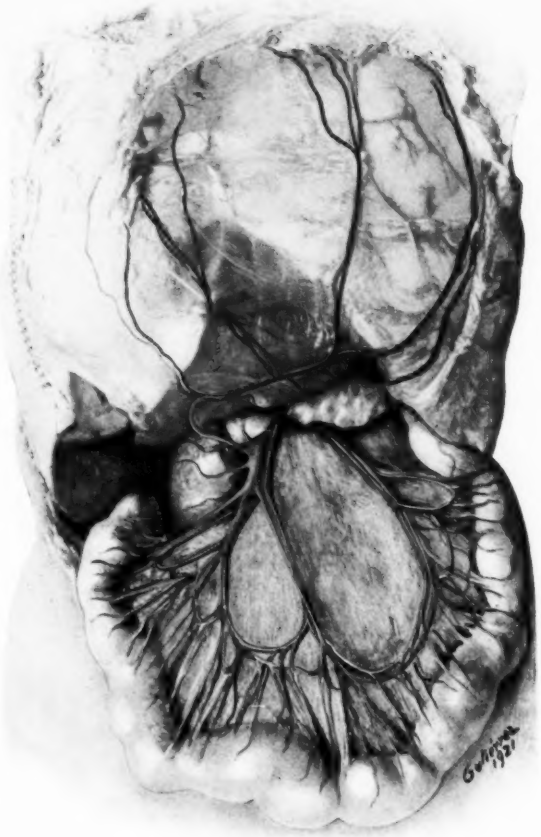

Fig. 6. The colo-epiploic sheet of coalescence has been separated with the colon and transverse mesocolon placed inferiorly and the great omentum reflected upward. The pancreas and upper portion of the second part of the duodenum are exposed.

spective places but at first retain their mesenteries and are freely movable.

Fixation follows accommodation with accompanying changes in the mesenteries and peritoneal relations.

Of the colon, only the transverse segment retains its mesentery, the cæcum becomes free, and the remaining portions become fixed to the posterior abdominal wall or the underlying viscera. Rarely the ascending and descending colons retain a very short mesentery.

Wherever the visceral peritoneum on the mesentery of a portion of the gut is placed in contact with parietal peritoneum or the peritoneum of another organ, the mesothelial layers of both are lost and the conjunctiva (fibrous layer of the peritoneum) become fused giving rise to connective-tissue sheets known as the sheets of coalescence. Wherever this fusion takes place between the visceral peritoneum of an organ and the parietal peritoneum the organ becomes retroperitoneal.

THE SHEETS OF COALESCENCE AS A MEANS OF ENTRANCE TO UNDERLYING REGIONS

These sheets do not contain vascular elements or nerves and are therefore especially desirable avenues of approach to the underlying regions.

Access to these regions may be gained by sectioning the peritoneum at the line of fusion farthest from the root of the primitive mesentery and reflecting the organ and its vessels toward the midline reproducing the embryonic mesenteries. This makes the segment freely movable (Fig. 3).

IMPORTANT SHEETS OF COALESCENCE

A brief discussion of the formation of each of the more important sheets of coalescence may serve to clarify their location and to bring out their surgical importance.

The retro-duodeno-pancreatic sheet of Treitz. When the stomach and duodenum rotate, the mesogastrium and mesoduodenum, containing the spleen and pancreas, are carried to the left in such a manner that the left side of the mesentery, duodenum, and the pancreas are brought in contact with the dorsal body wall. The result of this contact is an absorption of the two mesothelial layers and a fusion of the connective tissue underlying them. It is therefore possible to remove the duodenum and pancreas from the body wall by splitting this sheet of coalescence without danger of injury to their vessels and nerves (Figs. 2, 4, and 6).

The colo-epiploic sheet. As the dorsal mesogastrium develops into the great omentum and comes to lie over the transverse mescolon, the colon at this time having assumed a transverse position, the upper portion of the posterior layer comes in contact with the anterior layer of the transverse mesocolon and fusion occurs. Here there is formed a sheet of coalescence which may be taken as a route to the posterior wall of the stomach and the anterior surface of the pancreas without destruction of vessels. The advantages of this means of approach to the stomach in doing gastroenterostomies will be discussed later.

The posterior duodenal sheet. The rotation of the duodenum to the right and its subsequent opposition to the anterior surface of the right kidney and the inferior vena cava results in the formation of a retroduodenal sheet which makes possible the reflection of the descending and transverse portions of the duodenum to the left with an exposure of the hilus of the kidney and the posterior surface of the duodenum (Fig. 1).

The sheet of coalescence of the lower ileum and ascending colon. After the cæcum and lower portion of the ileum shift to the right inguinal region, the ileum and occasionally the cæcum become fixed to the posterior abdominal wall. These portions may be mobilized by reflecting them toward the midline (Fig. 2). By carrying the procedure upward the entire ascending colon and the right extremity of the transverse colon may be mobilized. Such an exposure would bring to view the right kidney, descending and transverse parts of the duodenum, head of the pancreas, ureter, internal spermatic artery, and the inferior vena cava.

The retrocolic sheet of Pierre Duval. The descending colon and frequently the iliac portion of the sigmoid colon become fixed to the posterior wall forming the retrocolic sheet of Pierre Duval. The reflections of these segments of the gut to the midline expose the structures lying on the left posterior abdominal wall (Fig. 3).

Fig. 5. Mobilization of the spleen and pancreas (body and tail).

THE APPLICATION OF A KNOWLEDGE OF THE SHEETS OF COALESCENCE TO SURGERY

Through a knowledge of these sheets the various fixed sections of the alimentary tract may be made movable, and the operative technique in abdominal surgery thus simplified. After the fixed portions of the gut are freed they may be brought to the surface of the abdomen; this facilitates the execution of the most difficult details of section and anastomosis, and at the same time diminishes considerably the danger of contamination of the cavity.

Mobilization of the duodenum greatly simplifies investigations for concretions at the retropancreatic choledochus and the gastroduodenostomy of Villar-Finney or any gastric anastomosis, especially that of the end-to-end type after pylorectomy.

In operations for the reduction of fixed hernia of the ileo-cæco-colonic segment or of the sigmoid colon, the preliminary step is mobilization of the gut.

When the cæcum has secondarily become fixed and the appendix is retrocæcal, to expose it, it is necessary to free the cæcum and the lower portion of the ascending colon.

Renal and other retroperitoneal tumors may easily be operated on by the abdominal route if the colon is first made mobile (Figs. 2 and 3).

Commonly the spleen remains mobile in the left wall of the omental bursa, its mobility being limited by the lieno-renal and splenopancreatic ligaments posteriorly (Fig. 5) and the gastrosplenic ligament anteriorly. It sometimes occurs that the fusion of the posterior mesogastrium with the parietal peritoneum of the posterior wall extends so far to the left that the spleen is partially fixed. Donald Balfour, of Rochester, for several years has taught that in these cases the operative technique of splenectomies may be simplified by mobilization of the fixed portion of the spleen.

Since 1921 I have mobilized the tail of the pancreas and spleen in these operations.

Excellent methods have been described for mobilization of the head of the pancreas in the execution of duodenocephalic pancreatectomies. These do not apply to operations on the body of the pancreas which have been effected without any specialized method. As has been pointed out, it is possible to reach the

body of the pancreas by splitting the colo-epiploic sheet of coalescence (Fig. 6).

Separation of the colo-epiploic sheet offers great advantages in gastric surgery, in fact, once the separation is effected and the omental bursa is opened, the entire posterior surface of the stomach is exposed. It is then possible to discover and suture gastric perforations. Adhesions of the stomach to the anterior surface of the pancreas may also be isolated.

It is easier in gastro-enterostomies to take the jejunum through a mesocolic rent to the stomach after the colo-epiploic sheet is separated than to carry a portion of the posterior wall of the stomach through the transverse mesocolon to the jejunum, as in the classical method; for very often the gastric cone that is exposed is too high above the pylorus. In such cases one of the fundamental precepts of surgery is violated, the stoma being too great a distance from the pylorus.

A STUDY OF THE INFLUENCE OF PROTEIN THERAPY ON EXPERIMENTAL STAPHYLOCOCCUS INFECTION OF THE CORNEA OF THE RABBIT[1]

By BEN WITT KEY, M.A., M.D., F.A.C.S., New York

I FEEL that it may be fitting and opportune at this time to discuss a phase of the subject of protein therapy not heretofore referred to or discussed in connection with this work, but one, however, which is of especial importance in arriving at conclusions about it. I refer particularly to the study of the influence of protein therapy on experimental staphylococcus infection of the rabbit's cornea, which of course must be regarded as fundamental in theory and in the practice of protein therapy.

I shall not review the history of this therapy or discuss the theory of the non-specific reaction and its probable mechanism of effect. Nor will I touch upon the now changing standards of immunity in this connection. Nor can I but refer to what is known today as "colloid chemistry," and the "colloidal state" of given substances (according to August Lumiere and Kopaczewski). Although these theoretical and chemical phases of the subject are of intense interest, and we hear recently from Professor Lumiere that "the mechanism of the mysterious colloids holds in suspense the future progress of biology," the time allotted to me will not permit more than a passing reference to these phases.

In this field of research the principles are no longer recognized as entirely opposed to the accepted standards of bacterial activity, of specificity and immunity. This status has come to pass through the pressure of insistent demand on the theorist by the accumulating evidence of clinical results in human and in animal experimentation. Although Ehrlich's side-chain theory may best explain the specificity and mode of action of various antibodies, there is a growing tendency to explain many of these reactions on a physicochemical and colloidal basis. Antigens are substances that cause antibodies in the body fluids. And without exception antigens are colloids and are usually protein in nature. Furthermore, antibodies are colloid in their chemical characteristics, while they may or may not be solutions of colloids, they are, in the final analysis, products of cellular activity and, therefore, derived from colloidal solutions (colloid dispersions).

Now since there is no longer any doubt that the positive systemic reaction to protein injection is a valuable therapeutic measure, it has become a matter of some debate as to the relative value of different *forms* of protein or different preparations of the same form. Also the problem of dosage and the timing of the injection in relation to other treatment offers a field for investigation which up to this time has not even been approached.

[1]Read before the Ophthalmic Section of the Clinical Congress of the American College of Surgeons, Philadelphia, October 26–30, 1925.

In respect to the former, that is, to the selection of the most suitable, highly potential protein available, antidiphtheritic serum, as it is now prepared, offers perhaps the best form of foreign protein for administration to the human. Because milk varies in its potential and toxic action, numerous commercial preparations are now undergoing experimentation. Normal horse serum, "aolan," "yatsencasein," "ciba" (cibalbumin, aseptic solution of egg-albumin), albumose, proteose, non-specific vaccines, etc. have not as yet been shown to possess with any certainty a more reactive and potential effect than has anti-diphtheritic serum. "Aolan" has been heralded as a preferable form because it does not produce a systemic reaction. This is strange, since a positive systemic reaction, that is to say, a moderate rise in temperature, et cetera, is *necessary* in order to establish the pre-anaphylactic stage of hypersensitivity and thereby increase resistance which is believed to be the therapeutic effect. Furthermore the dosage and reaction of other preparations are uncertain. The dosage of the serum is certainly more definite and its anaphylactic effects are more clearly understood. Banzhaf's method of preparing the serum by isolating the antitoxin globulins permits the use of a concentrated serum, which lessens the incidence of serum sickness and facilitates the administration of large doses. According to Park, this method gives a concentration of about six times the original potency. Darier, Frogier and others claim to have shown that it is ten times more potent than normal horse serum, which may be due not only to its high concentration and method of preparation, but also, perhaps, to the constituents attributed to the diphtheria bacillus or toxin.

Moreover, the theory as to the properties and structure of antibodies in immunity lends striking evidence (Vaughan, Kraus, Ichikawa, Ludke) that there may be a direct antagonist, a special antigen or protein (globulin) in the serum more active than a mere animal protein (milk, egg-albumin), the method of concentration of the serum adding to the concentration of the antibody elements in the serum. If there is any virtue to be had in the non-specific diphtheritic elements (colloids?) in the serum, there is a decided advantage and preference in antidiphtheritic serum over other forms of proteins employed in this therapy. Furthermore, the facility of obtaining and administering suitable doses of antidiphtheritic serum is a distinct advantage not to be overlooked.

As for anaphylaxis, a concentrated serum is not so likely to produce serum sickness as whole serum, since a smaller quantity of it is injected. The history of previous anaphylactic conditions, previous diphtheria, status lymphaticus, asthma or hayfever-like attacks in persons proved susceptible in a stable and horse environment are well established as probable contra-indications to serum injections. I have not observed serious anaphylactic effects in any case (now 170 cases treated), and doses have varied from 1,000 to 5,000 units; a total in one case of 12,000 units (given in 3,000 and 2,000 unit doses). These doses are pitiably small when contrasted with those frequently given even for prophylactic purposes in diphtheria (5,000 to 10,000 units), not to mention those employed for the full therapeutic effect (10,000 to 20,000 units). Verhoff recently reports the injection of 20 cubic centimeters (about 16,000 units) *every* day for a period of about a month in a case of sympathetic ophthalmia, in which case he claims a cure. My own experience, however, has taught me some respect for the highly potent effect of anti-diphtheritic serum, and also that small doses of 3 to 4 cubic centimeters (2,400 to 3,200 units) are harmless and yet are sufficient to produce moderate systemic reaction just short of anaphylaxis. It is well known that infections probably represent either an increase of pathogenic *power* on the part of certain micro-organisms or a disturbance of the defensive mechanism of the host whereby the normal relations are disturbed; and micro-organisms that normally are harmless become infective and disease-producing. The severe general reactions observed in acute anaphylaxis and after the first intravenous injection of a foreign protein, differ both theoretically and in their manifestations, yet, in a sense, the *results are not dissimilar*. In anaphylaxis, a sublethal dose given to a sensitized animal leaves it immune

to the toxic protein for a definite period, while, in the second instance, following a sharp general reaction there is frequently a marked improvement of the infectious process. In both instances there is an increased resistance to the action of the toxic agent, and the good results observed following non-protein injection may be an expression of the increased cellular resistance observed *in the stage of desensitization in anaphylaxis;* in other words, the cells have been made more resistant to the infectious agent by the foreign protein.

The time of injection and the size of the dose have been given much consideration and have been referred to with some emphasis in my previous reports. The matter of anaphylaxis is of importance in this regard because sufficiently large doses are essential, just as they are in the treatment of diphtheria, in order to produce a suitable reaction and effect. This is necessary because the serum is almost immediately effective (ten minutes after injection, Rosenau), and this stage of preanaphylactic effect, representing the incubation period of disease, is the period of gradually increasing sensitivity of the body cells to the protein or disease element (bacteria) as a measure of body defense against the invader. The first stage of anaphylaxis is known to be one of exhilaration and stimulation, followed by one of depression, paresis, arrest of breathing, etc. For this reason, it is my practice, after cauterizing an active ulcer of the cornea, to have the serum injected as soon as possible. For the same reason, we find an explanation for the constant observation that the effect of the serum is manifest always within 24 to 48 hours after injection, the time of hypersensitivity and cellular reaction. It is clear, therefore, that the time of the injection is important, as well as the size of the dose and the relation to local treatment.

In this connection, I believe it is generally recognized that a case of hypopyon keratitis in a strong healthy young individual is rarely seen; and when such cases are observed, intensive local measures alone quickly yield the usual good result. On the other hand, we find serpiginous ulcer of the cornea occurring commonly in the aged and in debilitated individuals usually following upon the neglect of a local injury, and the center of the cornea, the area least protected by systemic resistance, is the area almost invariably affected. Here, the problem of cause and effect is obvious. The question of virulence of the infecting micro-organism on the one hand and the defensive powers of the host on the other is evident.

In an effort to secure a fixed virus of staphylococci by standardizing the virulence of a certain strain through "passage," and then by suitable dilution of this virus, I have attempted to obtain that dilution which will produce by puncture of the corneal stroma the slightest but active ulceration of the punctured area. It is clear, that by this more certain means of standardizing the virulence and controlling the dosage of the infecting micro-organism, the matter of resistance becomes the more direct unknown quantity in the problem of cause and effect. It was found that these dilutions varied greatly with the different strains of staphylococci taken from various parts of the body, the most virulent strains being those taken from the eye. The dilution was as great as 1:30,000 (.01 cubic centimeter of bouillon culture of staphylococci diluted in 300 cubic centimeters of normal salt solution) in order to secure the minimum dosage that would produce the slightest but active ulceration of the rabbit's cornea. (One colony of the 24-hour culture of staphylococci in 10 cubic centimeters of bouillon was cultivated for 24 hours, when .01 cubic centimeter of the bouillon was diluted in 300 cubic centimeters of normal salt solution, thus making a dilution of 1:30,000.)

The practical value of this is evident in this study, because we are able thereby to observe the relative value of different forms of protein as well as the dosage necessary to produce the therapeutic effect; and from this, one can more definitely measure the resistance of the animal to the inoculation. Furthermore, it makes one realize how minute must be, as a rule, the average quantity of micro-organisms first infecting the eye in a clinical case of hypopyon keratitis or even in a penetrating wound, and therefore, if a highly potent protein can be injected before the infection has become overwhelming, a satisfac-

tory result, which otherwise may have been a calamity, is deserving of our knowledge of these facts.

Now with these theoretical and clinical phases of the subject in mind, the problem as it presents itself at this time is, first, to determine the relative value of injections of anti-diphtheritic serum and normal horse-serum concentrated in the same manner and containing the same nitrogen content, and thereby to elucidate the question of the immune body as a possible potent influence in the therapeutic reaction (para-specific effect?); second, to determine the relative value of different forms of protein (animal, vegetable, and bacterial), especially as to milk, "aolan," hemp extract, typhoid vaccine, and tuberculin (TO) as they affect staphylococcic and pneumococcic infection of the refractive media of the eye; third, to study the relative value of different methods of injection, that is, intradermal, subdermal, intramuscular, and intravenous; fourth, to demonstrate a maximum and minimum dosage in relation to the time and character of the infection; and fifth, to determine the effect of previously injected immunizing doses for prophylactic purposes.

Now in so far as animal experimentation is concerned, only a small part of the whole problem can be dealt with at one time, and yet each experiment carries with it many factors entirely separate in importance but each dovetailing finally into a more complete analysis and conclusion.

With this in mind, I have, during the past 2 years, confined my study to the inoculation of the true cornea with the staphylococcus pyogenes aureus, observing the effects of intramuscular injections of antidiphtheritic serum as against concentrated horse-serum, milk, and typhoid vaccine. But to pursue such an apparently simple outline of experimentation, one finds very soon that many unexpected difficulties arise, each of which must be worked out separately—problems within problems, for example, the method of inoculation, standardizing the virulence of the micro-organism, the correct dilution of the fixed virus, similarity of the animals, dosage of the protein injected, and many others of less importance.

In this series of 26 experiments, it was necessary to inoculate 94 corneæ. The same eye or the same animal was not employed when any effect from previous inoculation and possible immunity thereby could interfere in any sense with the correct interpretation of the results. The rabbits used in each experiment were about the same within reasonable limits as to size and weight. The same number of rabbits were used for controls as were used for injection. Usually 6 were inoculated in each experiment, 2 being injected with antidiphtheritic serum, 2 with typhoid vaccine (or milk or concentrated horse serum), and 2 used as controls.

In preparing the micro-organisms for inoculation, the culture was always grown on artificial media for 24 hours before inoculation. At first the cultures were made from infections of different parts of the body, but in the later experiments it was necessary to standardize the virulence of the micro-organism. For this purpose a strain from the eye was cultivated and carried along *pari passu* with a strain from another location for the purpose of studying relative virulence of each strain for corneal substance, at the same time both strains were being brought to their maximum virulence for the rabbit's cornea through "passage."

The method of inoculation was as follows: The eye was cocainized; the lids were retracted with the small rabbit-speculum; the superior rectus was grasped with fixation forceps; a small sterile hypodermic needle was introduced into the corneal substance at a point 2 millimeters from the upper limbus, carried horizontally by a twisting motion well into the deep stroma, and extended for a distance of 3 millimeters to the center of the cornea. After turning the needle three times completely around in this punctured wound in order to form a channel of the same size in each instance, it was withdrawn, dipped into staphylococcus emulsion and immediately reintroduced into the channel or puncture wound as before. It was now withdrawn and the needle at once plunged into agar media as a control. In the later experiments, instead of reintroducing the needle after dipping it into staphylococcus emulsion, 1:100 of a

cubic centimeter of the emulsion was injected by means of a finely graduated pipette into the corneal channel prepared by the needle puncture. The latter method proved to be more accurate, especially when we were dealing with high dilutions of a very virulent strain of staphylococci.

The method of injecting the protein consisted of inserting the needle into the flank of the animal just in front of the hind legs, and carrying the needle forward into the abdominal muscles so that the natural act of jumping might aid in the absorption and rapid assimilation of the protein substance.

The animals were observed daily after inoculation, and when necessary the ocular lesion was studied with the Zeiss magnifier for minute changes. Photographs were made in some instances when the observation was sufficiently clear and of some importance.

DISCUSSION

A study of these experiments shows the three stages of development which this work has undergone in the effort to secure delicate and accurate tests of the effect of foreign protein injection. The first stage embraces the first six experiments which show the comparative effects of protein injection when an unmeasured dose of staphylococci is used for inoculation, but in which nothing as to dosage of injection or delicate difference in effect could be observed because of the very violent corneal reaction due to too concentrated an emulsion of the micro-organism. The second stage is observed in experiments 7 to 19 inclusive, in which it was recognized that if the minimum dilution of staphylococci that would produce active ulceration of the cornea could be determined, more accurate and delicate observations would be forthcoming. The determination of the virulence of the staphylococci for corneal substance was attempted by first growing the micro-organism in the eye of an animal, the micro-organism being recovered, and the dilution of this employed for inoculation. But the varying virulence of the different strains of staphylococci isolated from different parts of the body upset this calculation as the experiments included in this stage demonstrate. Therefore, the third stage, which includes the last seven experiments (20–26), deals with the development of a more accurate method for determining the virulence of the bacteria, designed to produce more definite bacterial effects. This was accomplished by passing the strains used (one from an acute conjunctivitis, the other from an infected throat) through the eye of three successive animals, in an effort to standardize the virulence of the micro-organism for corneal substance.

The success of the method of inoculation, designed to bring about a definite and consistent corneal lesion, other things being equal, depends upon two important factors, the introduction of the needle, and the application of the same amount of the staphylococcus emulsion in every instance. The first is less important than the second because it is relatively a simple manipulation. When the needle passes into the anterior chamber or comes forward through the surface of the cornea, the event is readily observed and felt. In only two or three instances did either of these accidents occur in all the experiments performed, and in none of these were the results recorded. The second factor, application of the staphylococci, proved its importance through the experimental results. The puncture and repuncture method was fairly accurate when a concentrated solution was used, 1:100, as in the first six experiments. Obviously when so small an amount of the solution clings to the needle and is thus introduced into the sterile corneal channel, it reduces the dosage also by the mere passage of it. In higher dilutions (1:10,000; 1:30,000), this method was found to be uncertain, and perhaps inaccurate, and for the same reasons, as indicated by experiments 13 to 18. In higher dilutions, it was found to be more dependable to introduce into the punctured cornea 1/100 cubic centimeter of the emulsion from a finely graduated pipette, as noted in experiments 7 to 12. For this reason the latter method was used in the last seven experiments (20 to 26) in which the question of dilution and virulence was being tested.

Dilutions of the staphylococci emulsion varied from 1:100, (used in the first six experiments), to 1:30,000. At first it was

thought that the character of the corneal lesion depended solely upon the dilution. As shown in experiments 11 to 19, it was found that the dilution necessary to produce a definite corneal lesion was dependent upon the virulence of the micro-organism.

An attempt was made to obtain a virulent strain by passage of a certain strain through the anterior chamber of the eye, experiments 7 and 14. But this was found to be unreliable because one strain proved to be more virulent than the other, and one of them of such low virulence that, as shown in experiments 12, 14, 17, and 18, a very small lesion or even no lesion at all developed as a result of inoculation, although a dilution of 1:10,000 was used.

Finally, an attempt was made to standardize the virulence of two different strains of staphylococci by passing each strain successively through the cornea of three rabbits. This led to the interesting observation that the staphylococcus from acute conjunctivitis was *in every instance* more virulent than the strain cultivated from an infected throat, as shown in experiments 20 to 26. In experiments 25 and 26 the corneal lesion from the throat culture was not so advanced as that from the eye culture, although the dilution of the throat culture (1:1,000) was five times as strong as the dilution of the eye culture (1:5,000). This is certainly definite evidence, demonstrated in every instance, 30 eyes being inoculated in experiments 20 to 26 inclusive, all 15 eyes inoculated from the eye culture showing more marked corneal lesions than the 15 eyes inoculated from the throat culture. Furthermore, this observation at once raises the question whether or not any staphylococcus from a corneal ulcer or acute conjunctivitis has greater virulence or specific effect for the cornea of the rabbit, and whether or not, through "passage," the virulence of staphylococci from other parts of the body can be raised to a virulence similar to that shown by a strain originally from the eye.

CONCLUSIONS

1. Such an investigation as this is dependent for its accuracy primarily upon the method of inoculation, the determination of a fixed virus through "passage," and the suitable dilution of this virus.

2. The method of injection, the size of the dose and the relative value of different forms of protein should be worked out with some degree of certainty from the outline of procedure finally demonstrated in these experiments.

3. These experiments also argue without variation in favor of that very interesting and important question of virulence of different strains of staphylococci for corneal substance, as evidenced by the unmistakably greater virulence of the staphylococci cultivated from the eye as compared with those cultivated from the throat. Whether this is entirely a specific effect or a mere variation in ordinary virulence remains to be proved.

4. In almost every experiment in which any difference could be noted, the animal which received the protein injection showed the least corneal reaction to the infecting micro-organism. No important difference, however, between the effect of anti-diphtheritic serum, concentrated horse-serum, and typhoid vaccine upon the infection could be observed in any of the experiments. Sterile milk, although tried in only two experiments (1 and 2), that is, 12 rabbits, showed no effect whatever, and the corneal lesions were similar in every way to those of the control animals.

From the clinical point of view may I conclude that I do not wish to be regarded as overenthusiastic about this subject, but I feel bold enough to challenge you to administer antidiphtheritic serum in your next 5 cases of penetrating wound with infection or of hypopyon keratitis, before the infection has become overwhelming, and then draw your own conclusions.

Furthermore, I wish to affirm that "colloid chemistry" in medicine has come to stay, and the sooner systematic and serious research of the varieties and forms of protein (animal, vegetable, and bacterial) and their particular reactions to infection is made, the more valuable will become our therapeutic strength to combat disease.

On the other hand, I wish to state with some seriousness that we should not draw con-

clusions about protein effects too quickly, but rather we should sift the data and take stock, as it were, from time to time as to what has been shown to be reasonably true about it. We cannot accept much that we hear and read, for protein therapy is too popular today to be all that is claimed for it. It is not a "cure-all" by any means. In such instances the credulity of the laity, and even the profession is at stake.

DISCUSSION

Dr. Alan C. Wood. Dr. Key's method of producing corneal lesions in animals with the minimal bacterial stimulus is, I think, quite important. It should be remembered, however, that the resistance of the individual animal to the bacteria is a factor which can definitely enter into the healing of the inflammatory lesion, and is a factor almost beyond our control. Such variations in the resistance of individual animals to a specific bacterial insult will, of course, cause definite variations in the healing processes which would follow the injection of a definite amount of non-specific protein, and this factor should be very definitely considered when the results as to the comparative value of the different non-specific proteins which may be employed, is considered.

Many years ago the Indian Plague Commission observed that anti-plague inoculations had a beneficial effect on miscellaneous infections and drew attention to the therapeutic rôle that non-specific protein might play. It was finally realized that any substance which would produce a general shock reaction often produced a therapeutic change. This reaction to non-specific protein has been the subject of a great amount of study. This reaction is characterized by the chill which follows the injection of the non-specific protein, by the febrile reaction, with fever sometimes of 100–106 degrees falling to normal within 24 hours; by the increase in the pulse rate, by the nervous irritability, the increase in glandular activity, nitrogen metabolism, and permeability of the blood vessels, later followed by a decrease in the permeability, and an increase in resistance to poisons, by increase of lymph flow, by lymphocytosis, chiefly of the polymorphoneutrophiles and more rarely of the eosinophiles, and the mobilization of the proteolytic enzymes and lipases, with a decrease in the anti-ferment content of the serum, occasionally by the mobilization of specific antibodies, and lastly the occurrence of a definite focal reaction around the focus of inflammation.

The inflammatory focal reaction is of special interest to us as ophthalmologists. It has been shown that every inflammatory focus will give a focal reaction after injection of a non-specific protein. Schmidt has shown that a localized inflammatory process, non-tuberculous in type, will react to an injection of tuberculin and other non-specific agents, nucleoproteins, nucleins, etc. Wolff-Eisner has recently stated that he believes this is due to a sensitivity against protein in general which is produced by a localized inflammatory focus. This focal reaction is definitely diphasic in character, characterized in the primary phase by an increase in the inflammation, in the secondary phase by a decrease in the inflammation and healing.

Numerous theories have been advanced by different observers to explain the beneficial results which can follow non-specific protein therapy. Weichardt has supposed it to be due to a plasma activation, resulting in a stimulation of the cell metabolism with a production of substances, antibacterial in nature, and a detoxication. Paltauf and Lowrey sought to explain the benefit of the non-specific protein therapy on the grounds of stimulation of the heat regulatory mechanism. Hektoen, Ludke, Bull and others have shown that following non-specific protein therapy there frequently results the mobilization of the antibodies specific for the primary infecting agent, and they believe that non-specific protein therapy may owe its beneficial effects to the fact that certain exciting agents are imperfect antigens containing the stimulus necessary for the production of antibodies by the cells, but not the "exfoliative stimulus" necessary to cause the cells to throw off these protective antibodies into the blood stream. Such "exfoliative stimulus" they believe was supplied by the non-specific agent. Starkenstein, who has done extensive experimental work on the eye, following the injection of non-specific protein, believes that the beneficial effects are due to the secondary phase of decreased permeability of the blood vessels, with the resultant greater resistance to poisons. Jobling and Peterson have brought much evidence to show that the mobilization of the proteolytic enzymes is the most important factor in the controlling of local inflammation by non-specific protein therapy, believing, in short, that these proteolytic enzymes act as detoxicating agents by degradation of toxic split proteins to non-toxic amino-acid forms, or by splitting up the protein to which the cells have become sensitized, thus rendering it non-toxic. More recently, as Dr. Key has said, the attempt to explain non-specific protein therapy on the basis of chemistry of colloids has been emphasized.

Further study of the non-specific protein reaction has shown that there are an enormous number of substances which are capable, in a greater or lesser degree, of provoking the typical non-specific reaction. Among such substances are the counter irritants, the normal and immune serums, antitoxins, proteins, egg-albumin, milk, milk derivatives, such as Dr. Key has noted, gelatin, nucleo-proteins, nucleohexyl, protein-split products, enzymes, tissue extracts, vaccines without number, bacterial extracts, colloidal metals, yeast, etc.

Observers who have studied the non-specific protein reactions most carefully believe there are very definite contra-indications to its use, and

leeway in the choice of the protein used. They have emphasized that the reaction is essentially diphasic, the first phase being characterized by the rather violent general symptoms and by the increase in the local inflammation, and the second phase characterized by the definite beneficial effects and the resolution of the inflammatory process as has already been emphasized. Therefore no patient should be submitted to this reaction unless the patient is a good clinical risk, well able to stand the augmentation of disease incident to the first phase. Further, inasmuch as when all is said and done, the effects of non-specific protein therapy are in the main dependent upon the stimulation of the cells, such non-specific protein therapy should be used while the cells are still definitely capable of stimulation, and it must of necessity be of less value when the cells affected are exhausted by long drawn out disease. The question of dosage should be most carefully watched, for deaths from excess dosages have been reported by Eggerton, Krause and Mazza, Borral and other observers; also Wischardt has shown that while small doses stimulate the cells, larger doses depress the cells. In the event that serums are used, the question of hypersensitivity to such serums should be carefully determined before the serum is injected into the patient. If the hypersensitivity is present, which can safely be determined by a preliminary skin test, the patient should be desensitized before the serum is administered. In the case of vaccines, proteoses, and milk, the question of hypersensitivity in unimportant, but in the case of serums, there is a definite danger which should be guarded against. Diabetes, pregnancy, and alcoholism are also said to be contra-indications of the use of non-specific therapy.

In the American clinics we find three proteins commonly used in the non-specific protein reactions. The first of these is milk, or some of its derivatives. This is certainly the mildest. The reaction which it produces is probably the most variable, as are likewise the therapeutic responses elicited. Antidiphtheritic serum is the second protein commonly used, but it has been remarked that the non-specific reaction elicited by the concentrated serum at present used, is not so sharp as that elicited by the original unconcentrated serum. The third protein commonly used is typhoid vaccine which may be used either subcutaneously or intravenously. With this serum the dosage can be much more exactly controlled, the response elicited can be prophesied with much greater accuracy, and therapeutic results obtained have been at least equal to those observed following other forms of non-specific protein therapy. Our choice of proteins in any clinic should not be limited to one protein. Nor should the non-specific protein reactions ever be used as a routine in any given type of case. While it is indeed one of the most valuable therapeutic weapons we have, it is nevertheless specialized therapy. The age and condition of the patient and the duration of the disease should be carefully considered before any specific protein is chosen. In the case of a debilitated patient, or when a mild reaction is desired, milk seems to me to be the protein of choice. In the event a more certain reaction is desired, antidiphtheritic serum may well be used after preliminary tests are made to determine the question of hypersensitivity.

If the local disease is advanced to any degree, a much sharper stimulus will probably be needed to activate an organism or cell fatigued by disease. If the patient is a good clinical risk, intravenous killed bacilli may be used. But in non-specific protein therapy, which should always be considered specialized and never routine therapy, no hard and fast rule should be laid down, our choice of protein and dosage should be governed by the reaction we desire to produce, and this should be controlled by the condition of the inflammatory lesion and the general condition of the patient.

Dr. G. Oram Ring: During an operation for cataract on a man 82 years of age the cataractous lens became completely dislocated into the vitreous. No further effort was made by the operating surgeon to remove it. A stroke of apoplexy 6 years before bespoke a definite cardiorenal history. The eye was in a condition of chronic iridocyclitis, with secondary rise of tension, and was nearly sightless. Constitutional and local medication relieved the pain, but lachrymation, redness, and tenderness remained, and 3 months later enucleation was done under general anæsthesia. Ten minutes after being returned to his room the patient stopped breathing, but respiration was ultimately re-established. After preliminary iridectomy the right eye was extracted April, 1924, under local anæsthesia to eye and lids. The following day the wound was healed, the anterior chamber reformed and the eye doing well. It so continued until the end of the fourth day. Violent endogenous infection next threatened the loss of the eye. A standard preparation of diphtheria antitoxin was employed together with the subconjunctival use of cyanide of mercury 1:3000.

In the cases previously reported, the protein therapy was regarded as having been the active agent responsible for the improvement since no cyanide was used. The protein in the cases I am reporting, was used in the first case 48 hours in advance of the cyanide and in the second approximately 24 hours previously. Improvement began prior to the use of the cyanide but was accentuated following the subconjunctival injections.

Ten cubic centimeters of the standard antitoxin solution was given in three doses with a total of approximately 1,630 milligrams of protein. The protein was administered at intervals of 48 hours, the cyanide closely following the last two injections.

The return of the normal tint to the iris was associated with the clearing of the cornea and anterior chamber and the absorption of the pupillary exudate. A flattened membrane remained above to which the iris was attached. The eye was quiet and perception and projection were normal. Two infected teeth proved to be the source of toxæmia and were

removed. The infecting agent was the usual streptococcus viridans. In September, 1924, an iridocapsulotomy resulted in vision of 20/50 plus.

In the case of Mr. B., I performed an uneventful preliminary iridectomy which was followed a few weeks later by the extraction of a so-called black cataract, the wound healing promptly with a resulting vision of 6/6. The eye continues in perfect condition. About 6 months ago a preliminary iridectomy was done on the fellow eye, followed about a month later by the extraction of a black cataract. Rather more than the usual pressure was required to complete the extrusion, but no vitreous was lost and the eye was left in what seemed to be a satisfactory condition, with the edges of the coloboma in normal condition and the pupil black. Considerable transparent, posterior cortex evidenced itself the next day by an astonishingly extensive amount of cortical swelling which marked the beginning of a lens toxæmia. The eye ultimately became comparatively quiet with good perception and projection and a rather dense membrane above to which the iris was attached. This was so dense for a time that I feared it would have to be incised with a De Wecker scissors. To the usual local treatment was added the antitoxin with the final addition of two intravenous applications of arsphenamin.

Despite all the attention the eye had received, at the end of 5 months it still had a slight recurring flush. Five weeks ago, under strict precautions, a V shaped iridocapsulotomy was performed. The following day the eye had the appearance of a low grade infectious uveitis with no improvement in vision, despite a satisfactory opening in the iris. We gave 4 doses of the antitoxin, the volume equaling in protein content that outlined, combined with an equal amount of cyanide of mercury, subconjunctival injections 1:4000. A vision of 15/30 is the result.

The teeth should be X-rayed in all cases. It seems to me important that we record with as much exactness as possible the protein content of our solutions. I am advised by an expert associated with one of our leading laboratories that the total solids in the antitoxin solutions vary from 14 to 20 per cent. Taking 18 per cent as an average, and deducting approximately 1 per cent for salts, 17 per cent would represent the average solids in one cubic centimeter. Converting the cubic centimeter into grams, and multiplying by the percentage of solids, we arrive at the total protein content.

DR. L. WEBSTER FOX: As to milk injections, conclusions from a digest of the literature should be considered first. It would seem that there was considerable conflict in the reports from the countless workers and observers in this field, and one would be led to believe that many of the reports were prejudiced from the very start either in favor of or against this form of therapy. The great weakness of the reports of an unfavorable nature is the very few cases cited by the observers making these reports. On the other hand those investigators who have had sufficient encouragement to continue the treatment in a series of a thousand cases for instance, must have had much greater benefit from their endeavors than their reports would indicate, otherwise, they would not have wasted valuable time in order to prove a worthless or dangerous procedure to have some value. We are greatly impressed by the uniformity in the reports of the Spanish and Spanish American workers, from widely scattered sections. They are all favorable. On the other hand, the Germans whose access to a good milk supply is not at all easy, give an array of complications that would frighten any clinician, and naturally they resort to laboratory refinements to produce something just as good. The treatment relieves pain, prevents infection, and does considerable good in purulent affections of the anterior segment of the eye.

Conclusions from our own experience. Our attention having been first brought to the matter by personal communication from two most reliable workers, namely Van Lint and Fernandez, we tried the treatment in the beginning as a prophylactic against postoperative and posttraumatic infection, with most encouraging results and then gradually began to employ it routinely in all cases in order to give it a fair trial. In this large experience we neglected to tabulate the cases so that we could present the data without fear of criticism. Our last 80 cases, however, have proved to us several things. First, the fever and leucocytosis are essential to the production of benefit. If there is neither, there will be no benefit. Often there is little or no fever but an increase in the leucocytes. In these cases there is scarcely any noticeable change in the condition for which the injections are given. In those cases in which the factor of bacterial contamination has been taken into consideration by preliminary examination of the milk, we find several little surprises. First, there is very little difference in the reaction between pasteurized milk, certified milk, and powdered milk (this being dissolved in sterile water immediately before injection). Such differences are not greater than those which might occur between two different examiners or on different days. It is also interesting to note that several specimens of certified milk showed a higher bacterial count than the ordinary commercial pasteurized milk, a fact that would be of value to pediatricians and call for greater vigilance in the issuing of such certificates. All patients were somewhat improved. In none was the condition made worse or was the patient made to undergo any unnecessary illness as the result of the reaction. The ocular conditions most benefited were corneal ulcer, purulent ophthalmia and other purulent conditions affecting the anterior segment. Infection seemed to be prevented in traumatic and surgical cases. Pain was relieved in many instances. We regard the treatment as safe, and a valuable adjunct to our therapeutics, but not necessarily important enough to replace other older and well tried measures. As compared to other forms of so-called protein therapy, we regard it as superior.

PELVIC HERNIA

Report of a Case of Posterior Vaginal Hernia[1]

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HERNIÆ occurring at the outlet of the pelvis have usually been classified into groups according to their point of appearance at the body surface. Thus they have been called pudendal, perineal, or vaginal. It would seem advisable, as in the case of other herniæ, to have one term which would include all those herniæ originating in a given region. For the herniæ into the inguinal canal, we use the one term "inguinal," and describe the variety by an added term "direct" or "indirect," while herniæ through the anterior abdominal wall, with the exception of those at the umbilicus, are called "ventral" herniæ.

Chase (3) believes that the term "levator hernia," as suggested by Blake, is the most appropriate, since it indicates the point of origin of these herniæ. While this term is most fitting for the pudendal and perineal varieties of these herniæ, it does not apply to those forms which occur in the midline anterior and posterior to the uterus, because at these two sites herniæ do not traverse the levator muscles or fascia but pass between the muscles.

For this reason the writer proposes the term "pelvic hernia" as being an inclusive term describing all herniæ through the pelvic floor, and the point of egress of the hernia added gives the subvariety of the hernia the same as in the inguinal herniæ. The recognition and use of this term would group these rare herniæ together under one main head for purposes of indexing histories and medical literature. It would also be consistent with the best usage in nomenclature of herniæ, bringing these cases into harmony with the terminology of herniæ, in general, which are named according to the point of origin and not of termination.

Herniæ through the pelvic floor are of rare occurrence. Moschcowitz (9) has reviewed the literature on the perineal variety of pelvic herniæ and accepted from the numerous previously reported cases, as genuine, 24 cases, and added 1 of his own, making in all 25 cases of the perineal variety.

Chase (3) reviewed the literature of the pudendal variety of pelvic herniæ, and found 12 cases previously reported and added 1 of his own, making a total number of 13.

As has been frequently pointed out, there are two possible points at which a hernia protruding into the vagina may originate, that is, posterior to the uterus in the cul-de-sac and anterior to the uterus between the bladder and the uterus. A hernia may also originate lateral to the uterus, either anterior or posterior to the broad ligament, and appear in the vagina covered by a complete sac of vaginal mucosa; this has been described twice, by Thomas (12) and by Etheridge (4). These cases will be taken up later.

In reviewing the literature on vaginal hernia, a greater degree of confusion of terms and description prevails than in either perineal hernia or pudendal hernia. Some authors have classified both cystocele and rectocele as vaginal herniæ, while by far the greater number of cases reported, on close analysis, turn out to be cases of prolapsus or descensus of the uterus accompanied by a bulging of abdominal contents into a distended cul-de-sac. Several cases were of complete traumatic rupture of the vaginal wall and cul-de-sac, with protrusion of uncovered intestines, and 1 case was an operative rupture of the cul-de-sac with protrusion of viscera.

Cystocele and rectocele should be excluded from the classification as herniæ. One of the requisites of a hernia of the abdominal organs is the presence of a peritoneal sac which is entirely lacking in these two conditions. They are really prolapses of the anterior or posterior vaginal walls.

In descensus or prolapsus of the uterus, accompanied by abdominal viscera bulging

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into the cul-de-sac, there is no true hernial sac and no ring or aperture through which the viscera herniate. The uterus descends because of stretched and attenuated cardinal and uterosacral ligaments; the cul-de-sac is enlarged and there is really a descent of the floor of the pelvis. This condition is properly termed elytrocele or vaginal enterocele. It goes without saying that complete rupture, whether traumatic or operative, with exposure of the bowels, is not a hernia.

Numerous case reports were found in the literature described as vaginal hernia, but few of the writers gave a clear description of the relations of the parts and the location of the hernial ring, merely stating that a vaginal hernia was present. Such cases were not considered as proved vaginal hernia and were rejected. But three cases observed clinically, without operation or autopsy, are considered in this report, although some of the cases rejected were probably genuine.

CASE 1. Taylor (11). Patient, age 22, 3 days postpartum "felt something give way within her that produced a sense of fullness in the upper vagina." Examination, 10 months after the onset of the tumor, was refused, and the symptoms were ascribed to prolapse of the uterus. A pessary was advised, but did no good. During a subsequent pregnancy, 3 months later, the mass increased in size. It could be reduced spontaneously. Following the second delivery the tumor mass increased in size, and on examination there was "found a tumor as large as a middle-sized oval pessary, occupying the posterior commissure of the labia, below their external surface. Tracing it up to the right sacro-iliac symphysis or an intermediate point between that and the mesial line, I discovered its surface to be smooth and continuous with the vaginal mucous membrane, its bulk diminishing at the slightest touch."

The accurate description and careful observation indicate that this is a true pelvic hernia of the posterior vaginal variety. The hernial ring was very evidently mesial to the uterosacral ligament and the hernial canal followed the posterior vaginal wall and appeared as a mass in the midline in the posterior commissure.

CASE 2. Etheridge (4). "The patient is 19 or 20 years of age and has 1 child 11 months old. When she was about 6 months pregnant, she 'jumped the rope' one day and after that she felt something come down through the vagina. She went to full term and had a normal delivery. Whenever she lifts or strains, the enterocele comes down, presses the vulva apart and comes out between the thighs. On examination I find quite a large opening in the roof of the vagina. The edges of the ring can be very well outlined with the finger, and when the hernia is down in the vagina the finger in the vagina is at once attracted by a pendant mass, and by pressing it a little one can determine that it is filled with gas. The opening comes down to the left of the uterus anterior to the broad ligament and posterior and left of the bladder."

The fact that this hernia descended into the vagina and not lateral to the vaginal canal, differentiates it from a pudendal hernia. There was also a definite hernial ring present. This case falls into the classification of pelvic hernia, anterior vaginal variety.

CASE 3. Barker (1). The patient, 32 years of age, in her third pregnancy, fell and shortly afterward discovered a mass protruding in the vagina. She had all the symptoms of strangulation of a loop of intestine, and on examination a soft mass about the size and shape of a glove finger was found in the vagina with a definite ring in the vaginal vault, posterior to the cervix and a little to the right of the midline; the ring was about 1½ inches in diameter. The mass was easily reduced. This case was carefully studied, as she was observed during eight successive attacks.

Only one case described as vaginal hernia has ever been reported at autopsy. The more regrettable, then, that the description is so meager as to leave us in doubt as to the exact location. This case was reported by Birchenall (2):

CASE 4. A woman, 63 years of age, died in 18 hours following an intra-abdominal injury received while at play. Autopsy was permitted. "The husband informed me that his late wife had long been the subject of what I inferred to be a vaginal hernia; but as it had caused her no particular inconvenience, she would not allow him to speak of it even to myself . . . . The viscera of the abdominal cavity were all healthy except the ileum; upon this there was a diffused bright scarlet patch indicating recent acute inflammatory action. Here on careful examination I detected a minute orifice. The hernia was indeed in the vagina, but it slipped back readily before the point of the finger."

The size, location, and direction of the hernia are not stated. I quote this only to show the paucity of the literature on this subject.

The case, previously referred to, that of Thomas (12), is of especial interest because it is the first case of vaginal hernia operated upon, because of the location of the hernial ring and the presence of a fibroid tumor which was evidently the cause of the hernia as in the case of perineal hernia reported by Moschcowitz (9).

CASE 5. The patient was a multipara, 39 years of age. For 6 years there had been present a mass in the vagina which had increased in size until it protruded from the vagina and hung down to the middle of the thigh on the right side. It could be reduced, but when in position caused severe pain in the bladder and rectum.

On examination, the pelvic organs were in normal position, and the bladder was in normal position in the pelvis. The hernia originated in the right vaginal fornix through an opening anterior to the broad ligament. It was proposed to perform a laparotomy and with the hernia held in reduced position by an assistant's hand in the vagina, to suture the sac into the incision in the abdominal wall. This was carried out and it was discovered that there was an extraperitoneal mass of fibrous tissue attached to the apex of the hernia sac which was removed by incising the peritoneum of the sac, and the operation was completed by suturing the sac into the abdominal wound. The patient made a good recovery.

Four cases of hernia occurring in the midline posteriorly and separating the rectum and vagina have reen reported at operation.

CASE 6. Huguier (6). The patient, 46 years of age, was operated upon November 18, 1911, for prolapse of the uterus, vaginal prolapse, and hypertrophy of cervix. First operation: Curettage, amputation of cervix, anterior colporrhaphy, perineorrhaphy, and abdominal hysteropexy, Doléris operation.

In May, 1912, the patient returned, stating that the condition had recurred. At examination a soft tumor about half the size of a mandarin orange was found in the midline, posterior to the vagina, bulging into the vulva. Rectocele was the diagnosis made. At operation a hernial sac was found in the midline of the vaginal wall separating the vagina and rectum. This was dissected upward for 8 centimeters and was opened, ligated, and excised. Operation was completed by suture in the midline of the levator muscles at several levels.

CASE 7. Lothrop (7). The patient, 41 years of age, multipara, suffering from lacerations at childbirth, in July, 1908, was operated upon for rectocele, cystocele, and abdominal fixation of uterus for prolapse. In December, 1908, she was operated upon again for rectocele. Again there was a recurrence of protrusion from the vagina. In 1909 she was delivered of a child, following which the mass increased in size. She was seen by Dr. Lothrop in September, 1912. At examination a mass the size of a fist was discovered protruding from the posterior wall of the vagina in the midline. It was easily replaced, disappearing on lying down. It was not a rectocele, as a finger in the rectum did not enter the tumor.

Operation was carried out by the abdominal route. The uterus was not prolapsed, but was still attached to the anterior abdominal wall. The neck of the sac was in the midline, at the bottom of the cul-de-sac; the sac contained coils of small intestine. The broad ligaments were divided close to the uterus, and the uterus was split in half and the anterior half including the uterine cavity was removed. The sac was then dissected out and the broad ligaments were turned down and sutured across the defect in the pelvic floor. The part of the uterus remaining was also sutured to the pelvic fascia at either side of the rectum, and the peritoneum was closed over both broad ligaments and the uterus.

She was seen 3 months after operation and there was no recurrence.

CASE 8. Hartmann (5). The patient, 30 years of age, was delivered of her first child at 22 years of age, a perineal laceration was repaired later. She was again delivered at the age of 24 and suffered from prolapse of the uterus which was corrected by an abdominal fixation of the uterus. Two years later a perineorrhaphy was performed. She was again delivered at term at 29 years of age. Following the confinement the prolapse reappeared with identical appearance as before the hysteropexy, only larger. She was seen by Hartmann in 1910, who described the condition as a large, smooth, round mass protruding from the vagina in the midline posteriorly. The tumor could be reduced by taxis with a gurgling sound. The perineum was thick and strong. There was no rectocele. The uterus was not prolapsed.

At operation in June, 1911, the hernia sac was dissected upward from the vaginal route, separated from the rectum and vagina, and excised above the level of the cervix. Coils of small intestine were found in the sac. The cul-de-sac was closed with sutures and the rectal and vaginal walls sutured together obliterating the hernial space. The perineum was reinforced.

The patient was again confined in April, 1913, more than 2 years after operation, and there was no recurrence of the hernia.

CASE 9. Sweetser (10). The patient, age 21 years, single, had never been pregnant. The past history was negative except for salpingectomy and appendectomy, apparently for pyosalpinx and, later, typhoid fever. Her present trouble dated from the attack of fever in 1914 when she noticed a swelling in the midline of the vagina posteriorly. This increased in size as she resumed her work. The tumor interfered with her work, though she experienced no sharp pain. The tumor would almost disappear in the recumbent position. The vaginal orifice was much relaxed, and, on straining, the posterior wall bulged inward, producing a tumor the size of a small orange, which was easily reducible. The uterus was in normal position. The perineum was intact and the rectum did not take part in the tumor.

Operation, perineal route. The hernia was dissected up to the level of the cul-de-sac, and then the abdomen was opened and the hernia ring was closed from above. No bowel coils were in the sac, which contained fluid. The abdomen was closed and again through the perineal incision the sac was ligated and excised, and the levator muscles were sutured over the stump. Convalescence was uneventful, but efforts to trace the patient were not successful.

AUTHOR'S CASES

CASE 10. Pu Chung Shih, a Chinese woman, 46 years of age, was admitted to the Peking Union Medical College Hospital on September 3. 1924. Her complaint was great swelling of the abdomen which had begun 2 years prior to admission and had increased in size until she was greatly distended. Her past history was negative. She had given birth to 3 full-term children, the last 19 years ago. She had been frequently "needled" by native Chinese doctors during the course of her disease.

Physical examination revealed a very emaciated woman with a greatly distended abdomen. The circumference of the abdomen at the umbilicus was 116 centimeters and from the xiphoid cartilage to the symphysis measured 62 centimeters. The abdomen presented to palpation a smooth tumor mass with a marked enlargement in the upper abdomen and another in the lower abdomen with a distinct depression above the level of the umbilicus. Percussion note was flat all over the abdomen. A distinct fluid wave could be detected on tapping the abdominal wall, and with the flat hand making sudden pressure in the flanks a wave of free peri-

Fig. 1. Sagittal sectional diagram showing condition found at operation.

toneal fluid could be seen and felt in the narrowed isthmus between the two tumor masses.

On vaginal examination the cervix was found to be high in the pelvis and the uterus was anterior, above the symphysis pubis; an elastic mass was felt filling the lower abdomen. In the perineal region a large protruding mass was seen, round, smooth, and covered by vaginal mucosa about 8 centimeters in diameter. A finger in the rectum detected the bulging anteriorly of the rectal wall into the tumor mass. No perineal body was present. Diagnosis was made of a large, multilocular cyst of the ovary and rectocele. At operation on September 4, 1924, an ovarian cyst weighing with its contents 41 pounds was removed. There was much free peritoneal fluid and the intestines and peritoneum were covered with a gelatinous exudate. The uterus was small and high in the abdomen. The small intestines were not in the pelvic cavity and the mesentery was short and strong. The abdomen was closed in layers and the patient was in good condition. Unfortunately there was no suspicion in my mind at the time that the perineal mass was anything but a rectocele, and the cul-de-sac was not explored. The patient's condition did not seem to warrant at that time the additional time under anæsthetic required for a perineoplasty.

Recovery was prompt and uneventful. Pathological diagnosis of the cyst was multilocular cystadenoma of the ovary. Before discharge from the hospital, the patient requested me to operate on the rectocele.

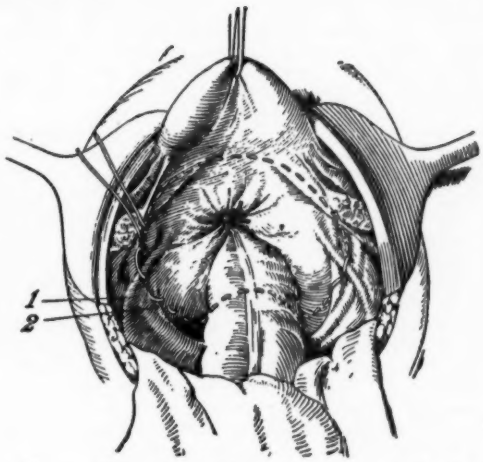

Fig. 2. Closure of cul-de-sac for pelvic hernia after Moschcowitz.

Operation, September 30, 1924. With the patient in the lithotomy position, a curved incision was made across the perineum along the muco-cutaneous border. The vaginal mucosa was dissected upward from the protruding rectum for a distance of about 2 centimeters, when a clear, thin-walled sac was encountered which contained fluid. This sac was carefully dissected free from the rectum and vaginal walls. It was 5 centimeters in width at the lowest point and gradually became narrower in the upper vagina. The vaginal mucosa was dissected up to the level of the cervix. The sac was freed to this point, and after it was determined that it contained nothing but fluid, the neck of the sac, which was about 2 centimeters broad, was transfixed and ligated with chromic gut. The opening of the hernia sac was in the midline at the most dependent point of the cul-de-sac. The space was obliterated by suturing the anterior rectal wall to the vaginal wall, and the levator muscles were interposed and the perineoplasty was completed in the usual manner.

Union occurred by primary intention, and the patient left the hospital in good condition. She lives in a village at a distance from Peking, and cannot be traced.

Case 11. Feng Wang Shih, hospital No. 11781, a Chinese woman, 36 years of age, V-para, was admitted to the hospital on September 18, 1925, with the complaint of great abdominal distention of 2 years' duration and general œdema of the lower extremities, cough for 2 months, and a mass protruding from the vagina. Menstrual cycle has always been irregular, the interval being 20 to 30 days, and since November, 1924, there has been complete amenorrhœa. Family history and past history were of no importance.

Physical examination showed a fairly well developed, well nourished Chinese woman, sitting up

in bed with considerable embarrassment of respiration. The heart was normal; the lungs were evidently displaced upward, as the liver dulness was considerably higher than normal; auscultation revealed moist râles throughout the chest.

The abdomen was greatly distended and was tense, fluid wave was elicited throughout the abdomen, and to percussion the abdomen was dull throughout. No intra-abdominal tumors or masses could be palpated. The circumference of the abdomen at the level of the umbilicus was 134 centimeters.

On vaginal examination we found protruding from the vagina, posteriorly in the midline, a pinkish, soft, fluctuant mass about 5 centimeters in diameter and 7 centimeters in length. Pressure on this mass caused reduction in its size, with no gurgling sound. The outlet was parous but not relaxed. Rectal examination showed no rectocele. The cervix was high and the fundus of the uterus could not be definitely palpated. No pelvic or abdominal masses were felt. Movement of the cervix and the uterus, with the fingers in the posterior vaginal vault, gave the sensation of moving a body through fluid.

The lower extremities were very œdematous.

The patient denied having been "needled" by Chinese doctors, but on the abdominal wall there were three shallow ulcers to the left of the midline below the umbilicus, which would appear to negative her denial.

A tentative diagnosis was made of vaginal hernia, ascites, and probably some tumor of the ovaries as a cause of the amenorrhœa and ascites.

Paracentesis of the abdomen was done on the evening of admission, and 25 liters of ascitic fluid were removed. After removal of this fluid, a large, irregular, nodular tumor could be palpated in the abdomen. This tumor extended from the pelvis to the costal margin, was more prominent on the left side, and was fairly freely movable but at the same time seemed to have attachments in the upper abdomen.

Following paracentesis, the œdema of the legs disappeared in 12 hours, the vaginal hernia disappeared, and the lung condition cleared up.

Our final pre-operative diagnosis was vaginal hernia, multilocular cyst of ovary with the possibility, because of the ascites, that the tumor might be a fibroma instead of a cyst.

Operation was performed on September 29 by Dr. J. P. Maxwell, Dr. Miles assisting. The tumor was found to be a large multilocular cystadenoma of the left ovary, with a twisted pedicle and numerous vascular attachments to the omentum. It was removed without great difficulty.

The pelvic condition was then explored. The cul-de-sac was found to be greatly enlarged, the uterosacral ligaments were stretched, and the cul-de-sac was much broader than normal and also deeper, a pouch the size of a large orange being formed below the uterosacral ligaments. The uterus had not descended but was higher than normal.

In the bottom of this enlarged pouch there was an opening that would admit a finger only, extending downward between the rectum and the posterior vaginal wall. This sac, when distended with ascitic fluid, must have been the protruding mass noticed at first examination. The writer then closed this hernial sac and the enlarged cul-de-sac after the manner described by Moschcowitz (8), by insertion from below upward of a series of purse-string sutures of medium silk, completely obliterating the cul-de-sac and uniting the anterior rectal wall to the posterior surface of the uterus up to the level of the internal os. This closure was not difficult.

The operation was completed by closing the abdomen in the routine maner. Convalescence was uneventful.

ANATOMICAL RELATIONS

From a study of these cases it will be seen that the herniæ which appear in the vagina most frequently originate in the bottom of the cul-de-sac, and the internal ring is formed by the two uterosacral ligaments and the anterior rectal wall. This occurred in 5 of the cases operated upon and apparently in 1 case not operated upon. In these cases the course of the hernia was directly in the midline separating the rectum and vagina and appearing in the vulva or protruding through it in the posterior commissure. The contents of the sac in 2 cases was fluid only, in 2 cases contained loops of small bowel, in 1 case contents of sac were not stated, and the cases not operated upon also quite evidently contained bowel. Of the 5 cases operated upon, two had no rectocele (Sweetser-Miles), while in the others rectocele was evidently present, as in 3 cases (Huguier, Lothrop, and Hartmann) the patients had undergone operations for correction of rectocele, and in the fourth (the author's case) rectocele was present and was demonstrated at operation. In one of the other operative cases (Thomas), the hernial ring was anterior to the broad ligament through the levator muscle, but the hernia instead of descending lateral to the vagina and appearing in the vulva appeared in the vagina, and the sacculated vaginal wall formed one of the covering coats of the hernia. This would appear to be the condition in the case of Etheridge, though in this latter the protrusion appeared more nearly in the midline anteriorly and was not nearly so large.

The muscles forming the levator ani group are interrupted in their perfect closure of the pelvic outlet by the rectum, the vagina, and the urethra. That herniæ do not more often occur in the midline between these tubular structures is very remarkable. The fusion between the rectum and vagina is not dense and their more frequent separation by the stretching of the peritoneum of the cul-de-sac would be expected. That it does not occur is probably due to three factors: the sigmoid colon is a thick-walled tube and because of its length is coiled over the weak spot in the bottom of the cul-de-sac supported by the uterosacral ligaments; the mesentery of the small bowels gives enough support to prevent undue pressure of these organs in the cul-de-sac; the normal inclination of the pelvis throws the weight of the abdominal contents on the anterior abdominal wall and the bony structures forming the anterior part of the pelvis.

ETIOLOGY

There is, of course, the same possibility that, in common with other herniæ, these herniæ may be either congenital or acquired. Failure of fusion between the rectum and vagina might occur leaving a weak spot into which the peritoneum of the cul-de-sac might be stretched under conditions of abdominal pressure; or there might even be a congenital peritoneum-lined space between the rectum and vagina. More probably trauma is the direct etiological factor, as all the patients reported but one were parous and had undergone the strain of pregnancy and labors. Repeated labor undoubtedly loosens the connective-tissue attachments of the uterus and vagina. This, together with abdominal or intra-abdominal conditions such as ptosis of the viscera, or increased intra-abdominal pressure due to tumors, or accumulations of fluid, causes the deepening of the cul-de-sac and a hernia to develop.

Herniæ between the rectum and vagina usually develop gradually. Of the cases studied, only 2 appeared suddenly, and there were signs of strangulation in only 1. Of the anterior vaginal herniæ, 1 appeared suddenly and 1 gradually, and neither showed signs of strangulation of hernial contents.

Fig. 3. Closure of cul-de-sac for pelvic hernia completed. (After Moschcowitz.)

SYMPTOMS

Since the usual course of development is gradual, the symptoms are mild. Incapacitation for work is caused by the inconvenience of the protruding mass and not as a rule on account of pain. Bladder and bowel disturbance may be noted. Symptoms are more marked in the anterior variety than in the posterior. Only 1 case (Barker) of the posterior variety showed signs of strangulation.

DIAGNOSIS

Patients who come to the physician because a mass protrudes from the vagina are *a priori* considered to be suffering from rectocele, and this constitutes the chief difficulty in diagnosis. Of the 6 patients operated upon, the diagnosis of vaginal hernia was made before operation only twice (Sweetser-Miles), and in 3 of those operated upon, the diagnosis was not arrived at during the first operation, though the prompt recurrence of the vaginal mass after operation would indicate that the hernia was present at the time of operation. Another difficulty arises from the fact that the internal ring is large, and that these herniæ disappear in the recumbent or lithotomy position. This latter point is one of the most important in diagnosis, that is, the presence of a mass in the

vagina or protruding from the vulva which disappears when the patient lies down, and reappears as the patient assumes the erect position or bears down with the abdominal muscles or coughs. Manual replacement of the mass, if it contains coils of bowels, should be accompanied by a gurgling sound. If the sac contains fluid only, this sign will be absent.

Hernia must be differentiated from vaginal cysts. Inclusion cysts in the lower vagina present a characteristic appearance, but cysts of the ampulla of Gartner's duct in the upper vagina might readily cause confusion. Cysts are without symptoms of strangulation, and are generally irreducible, though rarely a Gartner's duct cyst appearing in the vagina can be reduced on pressure, the fluid returning along the duct to a cyst of the parovarium in the broad ligament. Vaginal cysts are usually lateral to the cervix.

Diagnosis will probably be made most frequently at operation, and all large rectoceles should be suspected of being complicated by a hernia; and in all such cases the vaginal wall should be dissected high up and a search made for the hernia sac. Unless this is done, a small proportion of cases will apparently recur, the hernia will again protrude, and the patient will be dissatisfied with the treatment.

TREATMENT

Of the 6 operative cases reported, 3 were done entirely through the perineal route, 2 by abdominal route only, and 1 by combined perineal and abdominal routes. Only 1 case, that of Hartmann, done by the perineal route, has been followed up for a long period of time and apparently resulted in a cure. It would seem that the best results are to be obtained by a combination of abdominal and perineal operation. The sac should be dissected up to the level of the cervix and its contents reduced, the neck of the sac ligated, and the sac excised. The vaginal wound should be repaired in such a manner as to secure firm union between the rectum and vaginal wall, and the perineum repaired. Then if possible the abdomen should be opened, with the patient in the Trendelenburg position, and the cul-de-sac should be obliterated according to the technique devised by Moschcowitz (8), which consists in passing through the peritoneum and outer muscular coats of the rectum and vagina a series of purse-string sutures of linen or silk, and closing the cul-de-sac from below upward high on the cervix of the uterus. This was considered in my case, but as the patient had just undergone an abdominal operation we hesitated to re-open the abdomen, and hoped to secure relief by a less radical operation.

Such a radical operation as was performed by Lothrop does not seem to be indicated at the present time.

SUMMARY

The literature on the subject of vaginal hernia has been studied, and 9 cases which appeared to be definitely of this order have been reviewed, with 2 additional cases by the author.

The cause of these herniæ is with one exception found to be traumatic, following pregnancy or childbearing.

A new classification embracing all herniæ occurring through the pelvic floor is offered, following the general usage of terminology and classifying it according to its course thus: pelvic hernia may be perineal, pudendal, or vaginal; and vaginal pelvic hernia may be (a) anterior, or (b) posterior. Prolapse of the uterus accompanied by a general enlargement of the cul-de-sac and protrusion of abdominal contents into the vaginal vault should be called either elytrocele or vaginal enterocele, and not a hernia.

The treatment is operative, and the best operation is a perineal operation, by which the sac is excised and the perineum is repaired combined with an abdominal operation for obliterating the cul-de-sac.

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THREE CASES OF THYROID METASTASIS TO BONES

WITH A DISCUSSION AS TO THE EXISTENCE OF THE SO-CALLED "BENIGN METASTASIZING GOITER"[1]

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THREE cases of osseous metastasis of thyroid tissue are herewith reported. At the time of admission to the University of Michigan Hospital the three patients presented a symptomatology which directed the clinicians' attention chiefly to the bone tumors. The first was a case in which spontaneous fracture of the femur occurred, as a result of the presence of a tumor composed of histologically benign thyroid tissue. A small goiter gave no evidence of malignancy. In the second case, the metastasis was to the astragalus. Again the microscopical picture was that of typical thyroid tissue, and the patient possessed a small, symmetrical goiter which was regarded as clinically benign. The third patient presented signs of vertebral neoplasm with compression myelitis, but with no clinical signs which might direct suspicion to the thyroid gland. Laminectomy exposed a hazel-nut sized tumor in the sixth cervical vertebra, which, on microscopical examination, contained areas of typical thyroid tissue.

All these patients later developed unmistakable clinical evidence of malignancy of the thyroid gland, and all died within a year and a half following operation. One case came to autopsy.

"BENIGN METASTASIZING GOITER"

The bizarre character of primary and secondary neoplasms of the thyroid gland has long intrigued the interest of the pathologist and the surgeon. The alleged failure of these new-growths to conform to the generally accepted doctrines of neoplasia has led to widely divergent conceptions of their origin and manner of growth. The mysteries surrounding the physiology of the thyroid gland have been shared by its obscure pathology.

One outstanding incongruity concerns itself with the so-called "benign metastasizing goiters." In almost every instance those who have reported these cases have been struck by the paradox of simple goiters and benign thyroid adenomata with multiple metastases. Such an assumption is at once in direct contradiction of one of the most firmly established doctrines concerned with the biology of malignant new-growths. The development of multiple metastases has long been considered *prima facie* evidence of malignancy. The statement that metastases of thyroid tissue do not conform to this fundamental rule, at once places a heavy burden of proof on those who suggest such a possibility. As recently as 1923, Joll (43), in the course of a Hunterian Lecture before the Royal College of Surgeons, declared that "the thyroid gland may be quite normal in every way, and the metastasis may have either the structure of normal thyroid tissue, of an innocent thyroid tumor, or of a tumor exhibiting any degree of malignancy." One purpose of this paper is to weigh the evidence as it appears in the literature for or against the existence of such an entity, and to prove that there is no basis for the belief that thyroid gland tissue behaves

[1] From the Pathological Laboratory of the University of Michigan, Ann Arbor.

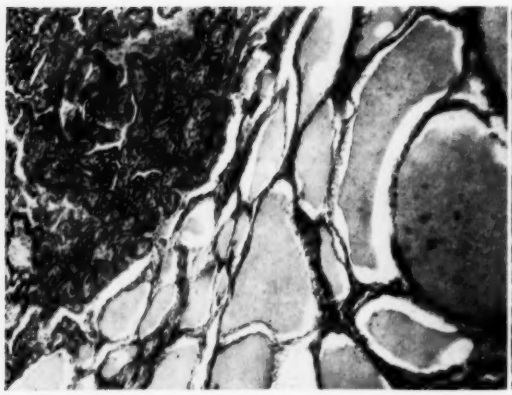

Fig. 1. Low power view of vertebral metastasis, showing large colloid-containing acini, surrounded by simple low cuboidal epithelium, immediately adjacent to area of papilliferous adenocarcinoma, devoid of colloid.

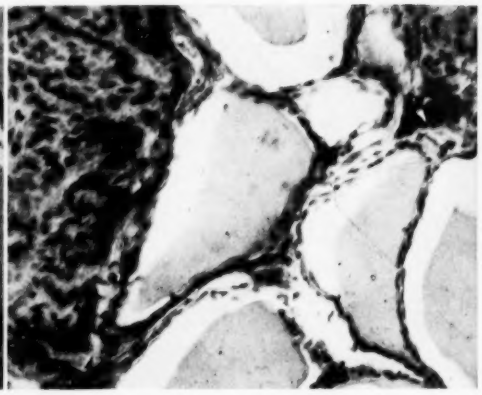

Fig. 2. High power view of vertebral metastasis, showing island of normal appearing colloid-containing acini, covered by a single layer of flattened cells, in the midst of an area of adenocarcinoma.

in a manner entirely different from that which characterizes all other human tissues.

The literature and textbooks have persistently referred to this extraordinary circumstance since 1876, when Cohnheim (7) first reported a case of this kind, which he designated "*Einfacher Gallertkropf mit Metastasen*":

A woman of 35 developed a painful swelling in the left knee, and dull pains in the left sacro-iliac region, accompanied by a hectic temperature. Aspiration of the knee joint gave relief for 6 months, after which the fever returned and a large left sacro-iliac abscess appeared and was incised. The deepest portion of the abscess was continuous with the bone, which was curetted. Rapid emaciation and death followed. Necropsy revealed many small pea-sized grayish-white to grayish-red, homogeneous, translucent masses in the lungs, with similar "gelatinous, honey-like" deposits in the walnut-sized bronchial lymph nodes. The skeletal examination showed invasion of the second, third, and fourth lumbar vertebræ with a reddish, raspberry-jelly-like mass. The bone marrow of the right femur contained a similar soft mass of hazel-nut size. The femoral cortex had been eroded from within, producing wide dilatation of the medullary canal. Both lobes of the thyroid gland were enlarged, the left more so than the right. The right showed normal follicular structure. In the left lobe were two large nodules. These showed a gelatinous structure identical with that of the masses in the lungs and bronchial nodes. There was no infiltration to neighboring structures. The smaller of the two gelatinous nodules had a small button-like mass which extended into a tributary of the inferior thyroid vein.

Microscopical examination of the gelatinous nodules in the thyroid gland, and those of the bones and lung and bronchial nodes revealed the structure of simple colloid goiter. The curettings from the gluteal abscess likewise showed the typical histological structure of thyroid tissue.

Cohnheim said, however, that a few of the follicles were completely filled with epithelial nests. His conclusion was that the new-growth in the thyroid was a simple colloid adenoma with multiple metastases. He rather slighted the significance of the direct growth into the vein by simply stating that it had been observed in many cases without metastasis. He attempted to explain the absence or presence of metastases in these cases of venous invasion by assuming that a special constitutional individuality made metastases possible in one instance and not in another!

In this case we have three important evidences of malignancy: first, multiple metastases; second, tumor-thrombosis of the inferior thyroid vein; and third, proliferating cell nests in the thyroid acini. So it would appear as though this original paradoxical assumption of benign tumors with multiple metastases was based upon a false interpretation. Since this first questionable observation, the literature has contained many analogous reports. That the writers of these subsequent similar papers were greatly influenced in their decisions by Cohnheim's interpretations as expressed in this original report, is indicated

Fig. 3. Photomicrograph showing metastatic papilliferous adenocarcinoma of thyroid origin in body of seventh cervical vertebra.

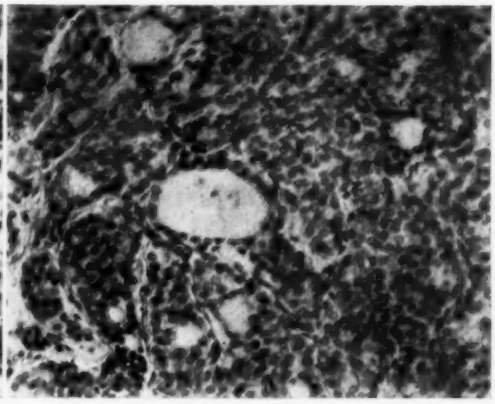

Fig. 4. High power view of thyroid metastasis to femur, showing well-defined colloid-containing acini, and smaller acini of the fetal type devoid of colloid.

by their almost invariable reference to this first recorded case. A résumé of many of these cases will be found at the end of this paper. A search of the literature reveals 77 cases of so-called metastasizing goiter. Many of these cases were discovered in reports in which the title gave little hint of their content and it is quite probable that there are many other similar cases with their identity hidden by irrelevant titles.

Four years after Cohnheim's report, Morris (55) told of a somewhat similar case in the Transactions of the Pathological Society of London (1880). The inadequate study of this case, with no examination of the thyroid gland and a very limited autopsy, leads only to the conviction that no accurate conclusions can be drawn from such cursory examination. Nevertheless, this paper marked the beginning of a long series of similar English case-reports.

ECTOPIC ANLAGEN THEORY

Honsell (36) made a spirited defense of Cohnheim's theories. He discussed at length the possibility that the metastases might represent displaced thyroid anlagen, particularly as in his case the thyroid tissue in the frontal bone first appeared at puberty. This last factor has no significance because practically every other case reported occurred in late adult life. It is now quite firmly established by careful embryological studies that even though aberrant thyroid tissue is a common developmental anomaly, it is always found in the immediate neighborhood of its primitive origin: the median derivative from the thyroglossal duct and the lateral paired derivatives from the ventral borders of the fourth pharyngeal pouches. Accessory thyroid masses may therefore be found anywhere from the foramen cæcum of the tongue to the arch of the aorta in the median line as derivatives of the thyroglossal duct, or lateral aberrant masses may be found as remnants of the branchial cleft derivatives, usually about the middle of a line from the midclavicle to the tip of the mastoid process. Adenomatous, cystic, and carcinomatous degeneration of these detached islands of thyroid tissue is not at all uncommon. Rosstencher (78) found in the literature over 100 cases in which a tumor of the posterior one-third of the tongue proved to be thyroid gland. He emphasizes the frequency with which operative removal is followed by grave symptoms of myxœdema and tetany (9 to 22 per cent), indicating that all of the thyroid tissue, and possibly parathyroid also, may have come to lie in the tongue. Tyler (79) and Ashhurst and White (80) have reported instances of primary carcinoma of lingual thyroid, the former with extensive metastasis. Primary malignancy of lateral

aberrant thyroid tissue has been repeatedly reported (Schrager, 81; Wohl, 82; Pollard, 83; Gerster, 84; Greensfelder and Bettman, 85; Gutmann, 86; Hinterstoisser, 87; Kamsler, 88; Parcelier, Venot, and Bonnin, 89; Peyron, Ranque, and Senez, 90; Schiller, 91; Pool, 92; Berger, 93).

But to this rule which limits quite sharply the regions in which thyroid tissue may be found as developmental arrests, there is one exception. This concerns itself with the complex teratomata which may be encountered rarely in various parts of the body, but chiefly in the ovaries, testes, and sacral region. Six instances have been recorded in this laboratory in which trigerminal teratoid tumors (dermoid cysts) of the ovary have contained mature thyroid tissue, along with the other mixed tissues that make up these complex tumors. In two of these the thyroid mass was as large as an orange. In most, the structure was that of either a simple colloid goiter or an adenomatous colloid goiter. It is of interest to observe that thyroid tissue in ovarian teratomata of women of the Great Lakes region shows the same tendency toward goiter as that of the thyroid gland itself. One case in particular (Miss A. B., case 3026-AB) excites extraordinary interest because of the development of thyroid adenocarcinoma in such an ovarian teratoid inclusion. In this case, in addition to the areas of adenocarcinoma there were small islands of medullary carcinoma with marked vacuolization of the epithelial cells. Kovács (94) has recently described a case in which a thyroid-tissue tumor of the ovary was accompanied by the symptoms of exophthalmic goiter, which subsided after removal of the tumor.

Any argument that seeks to prove that distant masses of thyroid tissue represent ectopic thyroid anlagen is rendered further invalid by the fact that in many of the reported cases of "benign metastasizing goiter," there were multiple widely scattered foci of thyroid tissue. The claim of some authors that aberrant thyroid tissue may be the source of thyroid new-growths in the mandible, sternum, and clavicle, is rendered untenable by the fact that in the 77 cases herewith analyzed, the skull was involved 30 times, the vertebræ 25 times, while the clavicle and sternum were each invaded 9 times, and the mandible but twice. Furthermore, the cases of clavicular and sternal metastases were almost invariably associated with multiple metastases involving other bones.

INADEQUATE STUDY OF REPORTED CASES

Perhaps the most convincing argument against the existence of the so-called benign metastasizing struma is the fact that the great majority of reported cases were incompletely studied, and hence do not justify positive assertions. In 29 cases only (38 per cent) of the 77 which I have gathered from the literature was tissue from the thyroid gland examined microscopically. In most of the remaining cases the histological study was woefully inadequate. Such cases demand the study of many sections. It is still customary in many laboratories to examine routinely but one or two sections. It is obvious that no conclusions should be drawn following such cursory study. Most authors have merely stated that the thyroid gland showed outwardly no signs of malignancy, or that there was no recent accelerated growth. Such statements are of no value since a high proportion of cases of malignancy of the thyroid are discovered only after routine histopathological examination. A small pea-sized primary malignant adenoma, or area of adenocarcinoma, hidden deeply in an innocent-appearing thyroid gland can readily give rise to extensive osseous and visceral metastases. Von Eiselsberg (95), Woelfler (73), and Huguenin (37) have emphasized that the primary thyroid tumor may be so small that it is only with great alertness that it can be found, while metastases may be massive. In Huguenin's case, it was only after repeated searches that he discovered in the inferior pole of the left thyroid lobe a small whitish area, 4 by 5 millimeters, made up entirely of carcinoma cells.

And in only 33 per cent of the reported cases was autopsy done! It is even more interesting to note further that in many of those cases on which microscopic studies

have been made "atypical cell forms," "solid, round, or filiform islands of epithelium characteristic of rapidly proliferating cells," "cells with numerous mitotic figures," "polymorphism of cell cords," are variously described. Such statements create considerable doubt as to the benignity of the cells so described.

In most cases the report was published shortly after the discovery of the benign microscopic appearance of the metastases. The writers were apparently satisfied with the knowledge that the thyroid gland showed no external evidence of malignancy, and made little or no attempt to learn of the ultimate outcome. Such a course is unwise because of the extremely slow growth of most thyroid carcinomata, and it is quite probable that if the ultimate cause of death could be determined in these cases they would show a high proportion of deaths from unquestionable carcinoma of the thyroid. The experience of Alamartine and Jaboulay (1a) is a case in point. In 1908, they told of a woman of twenty-three years who had possessed a tangerine-sized goiter for two and one-half years. An orange-sized, pulsatile tumor developed at the upper end of the humerus, which was diagnosed "aneurysmal sarcoma." On auscultation, *bruit* was heard. During this time the goiter remained without modification of size or consistency. Resection of the upper portion of the humerus was done and the microscopic examination of the tumor showed typical thyroid tissue. The thyroid gland was not examined microscopically, and on the strength of the clinical benignity of the thyroid tumor and the innocent microscopical appearance of the metastatic tumor, it was thought to be a case of benign metastasizing goiter.

In 1911, Alamartine and Bonnet (1b) rendered a further report on the same case and told of the later development of multiple metastases in the right femur (with spontaneous fracture) and to the vertebræ, followed by death.

Further proof of this tendency to report such cases prematurely is to be found in the first and second reports of a case by Oderfeld and Steinhaus (58). In 1901, under the title "*Zur Casuistik der Knochenmetastasen von normalem Schilddruesengewebe*," they told of a woman of 58 with an egg-sized elastic tumor replacing the left frontal bone. It had attained this size in 3 months. It was diagnosed as sarcoma and extirpated. The tumor was exceedingly vascular and extended to the dura mater. The convalescence was uneventful and when the patient was seen a half year later there was no recurrence and she was in excellent health. Microscopically, the tumor was made up of normal appearing thyroid tissue. There were no enlargement of the thyroid gland and no palpable accessory thyroids.

In 1903, the second report (58) appeared. The situation had changed remarkably. Six months following the last examination mentioned in the previous paper, the patient was markedly emaciated and showed a chicken-egg-sized recurrence in the left frontal bone. The right thyroid lobe had undergone considerable enlargement; simultaneously there appeared a tumor in the right temporal bone which grew to the size of an apple. A walnut-sized tumor was found at the right sternoclavicular articulation. Death followed the surgical removal of the temporal metastasis. Complete autopsy was not permitted, but the upper sternum, clavicle, trachea and thyroid, and the frontal recurrence were removed postmortem. The sternoclavicular nodule and recurrence showed the same microscopical picture as previously—normal thyroid tissue. An encapsulated spherical nodule in the right thyroid lobe was recognized as the primary tumor.

Much stress has been laid upon the microscopic appearance of the secondary deposits. In a large measure the tendency to consider this whole group as benign has arisen from the fact that the metastases frequently look much like normal thyroid tissue or that they simulate benign thyroid adenomata. There is abundant evidence to indicate that a metastatic area of thyroid adenocarcinoma may indeed assume the appearance of typical thyroid tissue. Ewing (96) says: "The natural tendency of the metastatic thyroid cells to develop into normal thyroid tissue may progressively alter the structure of a secondary

growth, so that an original carcinomatous area may eventually appear adenomatous."

The fact that carcinomatous metastases may possess identical morphological characteristics as normal thyroid tissue is illustrated quite clearly by the first of our 3 cases, a description of which appears later in this paper.

Crone (9) studied 6 cases of supposed benign metastasizing struma and in 3 of these, tissue from the thyroid gland was later examined and undoubted evidence of primary thyroid carcinoma was found in each, even though there was no clinical evidence of thyroid malignancy.

In the abstracts of previously reported cases which concludes this paper will be found 5 cases (indicated by asterisk) in which the metastases showed the histological architecture of normal thyroid tissue, while microscopic study of tissue from the thyroid gland revealed areas of primary carcinoma.

Even though this tendency closely to mimic the mother tissue in cell structure and in colloid elaboration is highly developed in the metastases of thyroid new-growths, there are other tumor types which continue to perform in a more or less perverted manner their normal function. The enamel formation by adamantinocarcinoma, mucin formation by carcinoma arising in the bronchi or in the large bowel, melanin formation in the metastases of melanoblastoma, and keratohyalin production by squamous cell carcinomata, constitute common examples.

In addition to the marked morphological similarity between normal thyroid tissue and that found in these distant masses, there is proof of their ability to elaborate vicariously the specific internal secretion of normal thyroid cells. Von Eiselsberg (97) tells of a case in which total thyroidectomy for carcinoma was done by Billroth on a woman of 38, followed by typical signs of myxœdema and tetany. These persisted for 2 years and then gradually regressed and ultimately disappeared as a nodule developed in the sternum. The sternal nodule gradually increased in size for 2 years and showed marked increase in size during menstruation and regression following menstruation. Finally it grew very rapidly, causing excruciating radiating pains and, 4 years after its appearance, was extirpated. Grave signs of hypothyroidism developed following the operation and persisted. Microscopic examination showed colloid-containing metastasis of a thyroid adenocarcinoma. Ewald (98) and Gierke (21) have demonstrated iodine in such metastases.

DETACHED NORMAL CELL THEORY

Much has been said concerning the extraordinary vascularity of the thyroid gland and the intimate relationship existing between the normal thyroid cells and the blood spaces. Even the existence of an interposed basement membrane has been denied (von Eiselsberg). The defendants of the benign metastasizing goiter theory claim that it is mechanically possible for normal thyroid cells to become detached and carried by the blood to distant structures and there set up independent growth, ultimately assuming normal thyroid structure and function. The reason for this extraordinary growth-energy of normal thyroid cells has never been suggested. It certainly leaves the burden of proof with the metastasizing goiter adherents. If normal thyroid cells possess this power to proliferate in a congenial environment, and it would appear as though cancellous bone tissue provided such a favorable nidus, then it is strange that artificial autoplastic implantations of thyroid tissue to the long bones have not been followed by such proliferative and destructive growth. Then, too, if normal thyroid cells possess such an unlimited potentiality for growth in distant tissues and organs, the remarkable infrequency of this occurrence argues against its probability.

The question might be asked, if these are metastases of malignant epithelial tumors of the thyroid gland why do they not appear earlier in the regional cervical lymph nodes? Experience has shown that the metastases of thyroid carcinomata are almost entirely hæmatogenous, and that distant dissemination is usually out of all proportion to the local lymphogenous metastasis.

An analysis of the reported cases indicates that the metastases, while most frequently of slow growth, are not delimited, but in-

filtrate the neighboring tissues in an irregular fashion. The frequency with which osseous metastases have produced spontaneous fractures indicates that these metastases must infiltrate and produce bone absorption in the same manner as those neoplasms concerning which there is no question as to their frank malignancy. In our series of collected cases, pathological fracture occurred 12 times, and of these 7 were femoral and 5 were humeral.

PREDILECTION FOR OSSEOUS METASTASIS

The striking predilection of secondary epithelial tumors of thyroid origin for growth in bones, particularly in the cancellous vertebral bodies and in the diploe of the cranial bones, is manifested in the reported cases of "metastasizing goiter." The following table represents the relative frequency with which the various bones were involved:

Skull	30 times	Femur	9 times
Vertebræ	25 times	Ribs	7 times
Pelvis	11 times	Humerus	7 times
Clavicle	9 times	Scapula	3 times
Sternum	9 times	Mandible	2 times

In every case but 4, it was the bone tumor which produced the symptoms which caused the patient to seek medical aid. In this way they simulate carcinomata arising in the prostate and renal hypernephromata, which frequently give signs of osseous metastasis before the primary new-growth has been discovered.

Most of the thyroid bone metastases have been diagnosed clinically and roentgenographically as sarcomata. This emphasizes the need of considering secondary tumors, particularly those originating in the thyroid, prostate, breast, adrenal, and kidney, in all cases of skeletal new-growth.

Two interesting observations that may possess diagnostic significance are the presence in the metastases of visible and palpable pulsations, synchronous with the heart beat, and the tendency of the metastases to fluctuate in size during menstruation and pregnancy. *Bruit* has been heard on auscultation over many of the pulsatile osseous metastases. Pulsation is a particularly prominent feature in those metastases which arise in the diploe of the squamous cranial bones and erode the inner table of the skull and come to lie on the dura mater. Several instances have been reported in which a pulsating thyroid metastasis in the sternum or clavicle has been mistaken for aortic aneurism. Recurrence following attempted extirpation of solitary osseous metastases is common, even though the clinical evidence of recurrence may not appear for many years. Because of this tendency toward recurrence and spontaneous fracture with non-union, and in view of the relatively slow growth of thyroid carcinomata, amputation seems to be the most rational treatment in those cases in which the long bones are involved.

The reports of three cases from this laboratory tell us much regarding the manner of growth of thyroid tissue in bones. The first case illustrates quite convincingly the great variability in the histological appearance of the metastatic thyroid tissue. The second case was reported (1913) soon after the discovery of apparently normal fetal thyroid tissue at the site of a spontaneous fracture of the femur as another instance of metastases of normal thyroid tissue. The third case is likewise in striking analogy with the previously reported cases of benign thyroid tumors with metastasis.

REPORT OF CASE WITH VERTEBRAL METASTASIS

Mr. H. F., age 66, was admitted to the neurological clinic on January 28, 1910, complaining of sharp, shooting pains and weakness in the shoulders and arms. The pains began during April of the preceding year and at first involved only the left shoulder and arm. In December, weakness of the left upper extremity was noticed for the first time. During the month before admission the right upper extremity was similarly affected. He experienced a feeling of weakness in the lower extremities during the same period.

On physical examination the left pupil was smaller than the right. The forearms and hands were somewhat atrophied, especially the thenar eminences. Flexion and extension at the elbow and wrist, and the hand-grip were weakened. There was anæsthesia to light touch on the ulnar side of both hands, involving the entire fourth and fifth fingers and the ulnar half of the third finger. Triceps reflexes were absent on both sides. There was diminution in faradic irritability in the triceps and

on the ulnar side of both hands and forearms. There was no atrophy of the lower extremities. The movements of flexion and extension at the knee and ankle joints were weak, particularly on the left. The toes of the left foot were moved with difficulty. The knee jerks were exaggerated on both sides, more so on left. Bilateral ankle clonus and the Babinski reflex were present on both sides. Sense of motion and position of toes was lost. Just to the left side of the midline of the neck, posteriorly, at the level of the sixth cervical vertebra, was a tumor of walnut size. It was sharply circumscribed and the skin was freely movable over it. It was not tender to pressure. The patient had no idea how long it had been there.

The patient was transferred to the Surgery Clinic for operation with a diagnosis of "tumor pressing on spinal cord at about the sixth to eighth cervical segment." Laminectomy (fourth, fifth, sixth cervical vertebræ) revealed the presence of a soft, reddish, hazel-nut-sized, extradural tumor, apparently originating in the left side of the body of the sixth cervical vertebra. It was easily separable from the dura, with which it was in immediate contact.

Histopathological examination of this tumor showed many islands of colloid-containing alveoli, surrounded by a single layer of flattened epithelial cells. Other areas showed a papilliferous structure, with taller columnar cells and little or no colloid. The pathological diagnosis was papilliferous adenocarcinoma of thyroid origin. For many years the patient had possessed a small, soft, symmetrical goiter, which had never occasioned him any difficulty and which had not manifested any recent growth. Clinically, there was no evidence of malignancy.

Following the removal of the spinal cord tumor, many of the signs of spinal cord compression disappeared.

Seven months later the patient again appeared at the hospital with a return of the original symptoms, showing considerable loss of weight and strength. The thyroid gland had not changed in size or consistency during the interim.

Exploratory operation was done at the site of the original laminectomy, and the small bit of tissue removed showed microscopically only scar tissue and fat. The clinical diagnosis at this time was "tumor of the spinal cord, probably return malignancy." The patient died 2 months later.

At autopsy, the bodies of the sixth and seventh cervical and the first thoracic vertebræ were filled with a soft, reddish, spongy, vascular mass which was compressing the spinal cord in this region. The thyroid gland was but slightly enlarged, firm, and nodular, with no definite infiltration to neighboring tissues. On section, there were firm, whitish areas which yielded abundant "tissue juice" on scraping. A few of the cervical lymph nodes and the thymus contained small nests of similar tissue. Microscopic study showed the whitish areas in the thyroid to be made up of a primary papilliferous adenocarcinoma, probably originating in a papilliferous adenoma. The metastases to the vertebræ (Figs. 1, 2, and 3), cervical nodes, and thymus showed many similar carcinomatous areas, but there were large areas which looked exactly like normal thyroid tissue, with follicles of various sizes, filled with homogeneous colloid and surrounded by a single layer of low cuboidal cells, without mitoses or hyperchromatism or pluristratification, or any other evidence of an abnormal growth tendency. This extraordinary variability in the histological appearance of the metastases is a constant finding in all of our autopsied cases of frank carcinoma of the thyroid and many authors have emphasized it, notably Bell (3).

Certainly, histological examination of such innocent appearing masses at the time of operation would have given as much evidence in favor of a "benign metastasizing goiter" as has obtained in many of the cases reported as such, particularly in view of the apparent clinical innocence of the thyroid gland during the long period of observation. Yet, the evidence of malignancy in this case is established beyond a doubt.

REPORT OF CASE WITH FEMORAL METASTASIS

A woman of 69 entered the surgery clinic for treatment of a femoral fracture which had occurred 6 months previously. All attempts to promote healing had been fruitless. For 4 months prior to the fracture she had experienced painful sensations in the left leg and thigh. One day, while engaged in her household duties, she fell to the floor without any apparent reason, and upon attempting to arise discovered that she had sustained a spontaneous fracture of the left femur, just above the knee.

Exploratory incision was done to ascertain the cause of the delayed healing. Considerable soft, gelatinous, reddish tissue was found between the fragments. This tissue seemed indistinguishable from that seen previously by the surgeon in cases of bone sarcoma, so high-thigh amputation was done.

Microscopic study of the tissue between the bone fragments revealed acini of varying size surrounded by a single layer of cuboidal cells and filled with homogeneous colloid. The nuclei showed neither hyperchromatism nor mitotic figures. Many of the acini were small and devoid of colloid, having much the appearance of normal fetal thyroid tissue (Fig. 4). There was little to suggest a rapidly proliferating malignant growth. Because of its innocent morphology, it was thought to be a metastasis of normal thyroid tissue. The pathological report was received with great surprise and the surgeon's attention was directed toward the thyroid gland. A small goiter, common to this district, was found. The patient insisted that it had been there since girlhood and that it had actually diminished in size during the last few years. Clinically, there was no evidence of malignancy.

This case was reported by de Nancrede in 1913 as "a case of metastasis in the femur of normal fetal

thyroid tissue" (99). Through extensive correspondence with the patient's relatives and family physician, and examination of the death certificate, it has been learned that this patient subsequently developed a rapidly growing, hard, irregular goiter, with infiltration to the neighboring neck tissues and progressive signs of dyspnœa, dysphagia, and aphonia. Death occurred within 18 months of the operation from unquestionable carcinoma of the thyroid gland. Unfortunately, no autopsy could be obtained.

REPORT OF CASE WITH METASTASIS TO ASTRAGALUS

This case has many points of similarity to the preceding one. A middle-aged man complained of severe pain in his right foot and a feeling that the bones of his foot were "giving away." The roentgenological examination showed a distinct diminution in density in the astragalus and the diagnosis of sarcoma was suggested. At operation, the bone was soft, reddish, with much the appearance of firm currant jelly and cut with the resistance of cheese. Microscopic study of the tissue revealed the presence of typical thyroid tissue. Healing occurred *per primam* and the patient left the hospital. At this time the thyroid gland presented a small, symmetrical, soft enlargement with nothing to suggest malignancy. This case was likewise believed to be one of simple goiter with metastasis. Had this case been reported immediately following the operation, it might well have been considered another instance of benign metastasizing goiter. Two years later this patient died an asphyxiative death, with undoubted clinical evidence of carcinoma of the thyroid gland. The patient had left the hospital and necropsy was not done.

These last two cases might well have been considered instances of metastasis of normal thyroid tissue early in their clinical course. The ultimate exodus with frank carcinoma of the thyroid gland indicates that the microscopic appearance of the secondary growths is not a dependable criterion. No single case in the literature offers complete and convincing evidence of the innocent character of the tissue from the thyroid gland or of its metastases.

A study of the literature concerned with thyroid carcinomata indicates at once that great uncertainty has existed as to what constitutes malignancy in primary thyroid new-growths. There can be no doubt but that the metastases of thyroid carcinomata are subject to the greatest variability in microscopic appearance. This is as true in cases of undoubted carcinoma as it is in those which have been called "benign metastasizing goiter." It is this variability that has most frequently led to the contradictory diagnosis of innocent goiter with metastasis. To consider the possibility of such a circumstance as a benign neoplasm giving rise to multiple metastases is to question the validity of the few fundamental facts which we possess regarding malignant new-growths.

It would seem, therefore, with this abundance of evidence in contradiction to the benign metastasizing goiter theory that there is no such entity and that they represent in fact instances of unrecognized carcinoma of the thyroid gland with metastasis.

CASE 1. Alamartine and Jaboulay (1a) report the case of a woman, aged 23. There was pain and limitation of motion of the right arm, with a pulsating tumor in the upper right humerus which had reached the size of an orange. The patient had lost weight and a bruit could be heard. A diagnosis was made of aneurysmatic sarcoma of the humerus. The upper humerus was resected. Microscopic examination showed typical thyroid tissue.

A goiter had begun 2½ years previously and had reached tangerine size. It fluctuated with menstruation. There had been no modification in size during the development of the humeral tumor, no Basedow disease, no myxœdema.

Over a year after the operation, Alamartine and Bonnet (1b) reported: There had developed right-sided sciatica with disturbances of sensibility and muscular atrophy; pain on pressure over the upper extremity of the femur; weakness of the lower extremities; spontaneous fracture of the neck of the right femur while in bed; complete paraplegia; urinary retention; (vertebral metastasis); painful left thigh; and cystitis. Progressive cachexia was followed by death. *No microscopic examination of the metastases to the right femur or vertebræ* was made.

The thyroid gland underwent no change during the 19 months which had elapsed between the resection of the upper humerus and death; *and no microscopic examination of it was made. No autopsy was performed.*

CASE 2. Beilby (2). Male, aged 65. A tumor had obstructed the right nostril for 6 months. A diagnosis was made of sarcoma of the antrum of Highmore, and incomplete extirpation done. Microscopically the growth was typical thyroid tissue and areas showed "solid cellular appearance." The growth increased rapidly following operation. Death occurred 8 months after onset.

There was no hypertrophy of thyroid before or after operation. *No histological examination nor autopsy was made.*

CASE 3. Bell (3). A man, aged 48, had had pain in the right hip-joint for several months. The right femur fractured spontaneously while patient was in bed. A tumor then developed in the left iliac region. Death occurred 2½ years after the onset of illness. *Autopsy.* Femoral metastasis showed microscopically a structure resembling undeveloped fetal thyroid. The acinar arrangement was easily recognizable. The tumor was lined by cuboidal cells and contained thin colloid. Certain areas showed the same structure as thyroid adenomata. The iliac metastasis presented vesicles like those of normal thyroid but much more evident.

The thyroid showed neither general nor local enlargement. On section of the right lobe, three filbert-sized nodules appeared. Microscopically, two nodules show irregular arrangement of cells, change in shape, absence of colloid, and embryonic character of blood spaces; all suggest malignant adenoma.

CASE 4. Bontsch-Osmolowskij (4). In a woman, aged 53, a rapidly growing, firm, painless tumor developed in the right frontal bone 4 to 6 weeks after a blow received 6 months previously. It reached hazel-nut size. Extirpation had to be done in two stages because of severe hæmorrhage. A pulsating, grayish-red tumor extended to the dura mater, a portion of which was removed with the firmly adherent tumor. Microscopically, there were variously sized acini, filled with colloid, grouped in lobules, separated by vascular connective tissue. There were no solid cell masses. It resembled ordinary thyroid gland. The patient was in excellent health 3 years later. The thyroid showed large thickening, particularly the right lobe. There was no change during the 3 years after operation. *No microscopic examination and no autopsy was made.*

CASE 5. Carle (5). A woman, aged 50, had a pulsating tumor in the sternal region. Extirpation was followed by tetany, and death occurred 14 days after operation. *Autopsy.* The sternal tumor gave the appearance of alveolar cancer. There were many small metastatic nodules in the lung with typical thyroid structure.

Goiter had been present for 25 years. *No microscopic examination* was made.

CASE 6. Coats (6). Woman, aged 46. There was a soft, distinctly pulsatile swelling over the external occipital protuberance of 1½ years' duration. It was painful and fluctuated markedly but averaged pigeon's egg size. Death. *Autopsy.* Bone absorption (1¾ inches in diameter) had taken place in the region of the external occipital protuberance. The tumor was red and soft. Another tumor, ¾ inch in diameter, involving the parietal bone, both tables and diploë, was firmly adherent to the brain with pressure on the brain. There was present a third tumor in the right parietal bone (¾ inch in diameter), and two smaller areas nearby. Microscopically they were typical thyroid saccules. "Sometimes the epithelium fills the saccules."

The patient had had goiter for 16 years, the goiter being larger on the left. Inability to swallow or speak had gradually developed. At autopsy, both lobes were found enlarged with much calcareous deposit. Microscopically it was similar to the skull, showing changes common in endemic goiter.

CASE 7. Cohnheim (7). A woman, aged 35, had multiple gelatinous metastases in the lungs, and bronchial nodes. The second, third, and fourth lumbar vertebræ contained red, raspberry-jelly-like masses. The right femur and the left sacro-iliac junction were similarly invaded. All showed the structure of colloid goiter, with many follicles "showing epithelial nests within the colloid."

Both lobes of the thyroid gland were enlarged, especially the left. The left lobe showed two large nodules which on section presented the same structure as that of the nodules in the lungs, bronchial nodes, and bones. There was no infiltration of the surrounding tissues. The smaller of the two nodules had a small button-like projection into a tributary of the inferior thyroid vein which was histologically similar to the metastatic nodules.

*CASE 8. de Crignis (8). A man, aged 58, about a half year before examination noticed a pulsating tumor in the right gluteal region. He had previously felt intense pain in the upper right thigh, radiating to the calf and foot. The right pelvic bone was swollen to the size of two fists; not circumscribed, soft, strong pulsation. Diagnosis: aneurism of superior gluteal artery. At operation a very vascular tumor was removed with the curette. Death occurred 3 hours after operation. *Autopsy.* Microscopically the tissue showed closely placed cavities of different size, surrounded by a single row of cubical epithelium with large round nuclei, filled with homogeneous colloid. There were dense connective tissue septa, and infiltration and absorption of bone.

The patient had a small palpable goiter, but no enlarged regional lymph glands. At autopsy the thyroid was not much enlarged. In the upper right lobe was a cherry-sized brownish nodule. In the middle of the right lobe was a pea-sized encapsulated light yellow nodule. In the left lobe was a round nut-sized encapsulated nodule. Microscopically the left thyroid nodule showed regularly placed, variously sized vesicles covered with small cubical cells and filled with homogeneous colloid. The nodule was encapsulated. No infiltration was present. The smaller right pea-sized nodule contained cells of medium size, containing very little protoplasm, large round nuclei; some mitotic figures; cells deposited in solid strands and heaps, radiating irregularly. A few small follicles were filled with colloid. The capsule was infiltrated by tumor cells. A diagnosis of adenocarcinoma was made.

CASE 9. Crone (9). A woman, aged 73, for 2½ years had had a swelling and pain in the left shoulder. Two years previously she had sustained a fracture of the left humerus without healing. She was emaciated. During resection a tumor was found which reached the vascular-nervous plexus. The humerus fractured during manipulation. Healing occurred. In the fist-sized tumor (9 by 6 centimeters) of the upper shaft of the humerus could be seen grossly colloid containing follicles. Microscopically it was encapsulated by a cellular, vascular connective tissue. There was no infiltration of the capsule. It was for the greater part a benign colloid goiter with areas of old and fresh hæmorrhage. There were areas of smaller follicles with less colloid and cylindrical epithelium (goiter parenchymatosa), and many strands of epithelial cells simulating adenocarcinoma.

The patient had had an enlarged thyroid for many years, but no recent accelerated growth. She gave no complaints. The goiter nodule was hard and movable. There were no signs of compression, and no recurrent nerve paralysis. Clinically it was a benign goiter. The goiter showed no change during the year following operation. *No autopsy and no microscopic examination* was made.

CASE 10. Dercum (10). A woman, aged 56, one year following partial thyroidectomy had shooting pains and progressive wasting of the left upper extremity. Later there were pains in the right hip followed by gradual contracture of the right lower extremity. The left lower extremity was ultimately similarly affected. Then the right upper extremity showed wasting with severe pain. There was marked kyphosis in the dorsal and lumbar region. There was a tumor at the sternal end of the left clavicle. The Babinski reaction could be elicited on the right side. There were multiple areas of paræsthesia, and multiple trophic ulcers. Death. *Autopsy.* There were red, fleshy, gelatinous tumors of the sternum, ribs, eighth and ninth dorsal vertebræ, sacrum, second lumbar vertebræ, and skull. The spinal cord was flattened by a tumor of the fourth and fifth cervical vertebræ. Microscopically (only cord and cervical tumors were examined), "all revealed typical structure of the thyroid alveoli, lined by a single row of cubical epithelium and filled with characteristic colloid material." Patient had had a goiter for many years. Partial thyroidectomy had been done 6 years ago for aphonia and dyspnœa. Grossly the tissue was normal thyroid. *No microscopic examination* was made.

CASE 11. Devic and Beriel (11). A woman, aged 54, entered the hospital with signs of myocardial failure, and died 2 hours later. *Autopsy.* There were œdema of the lower extremities and cardiac hypertrophy. In the right ventricle was an elliptical tumor, measuring 18 by 13 millimeters, near the pulmonary valve, which was lighter in color and softer and more elastic in consistency than the surrounding tissue. It resembled a uterine myoma. Histologically it was thyroid tissue with large and small follicles filled with colloid. The surface was covered by intact endocardium. It was separated from the myocardium by fibrous tissue of varying thickness, but continuous. There were areas of firm connective tissue containing nests of epithelial cells arranged in minute vesicles, without colloid. At one point, between the muscle bundles in the immediate neighborhood, was a small circumscribed nest of thyroid follicles.

The thyroid gland was normal in size and presented no abnormalities. *No histological description* was given.

CASE 12. Ehrle (12). A woman, aged 53, had a tumor of hazel-nut size on the right parietal bone. Signs of cerebral compression appeared 3 years later. The tumor grew to be the size of a child's head, was fluctuating and elastic. No further tumors were detected clinically and no operation was performed. Death. *Autopsy.* The parietal tumor infiltrated the dura mater. There were several pea-sized nodules in the lung—soft, yellowish, marrow-like. Microscopically, the picture of a simple colloid goiter predominated, though single cell heaps without glandular form were present. Lung metastases showed similar structure.

The patient had a small goiter which had been stationary for many years, and had remained unchanged during the 3-year interim. Histologically it was a simple colloid goiter. However, there were present numerous solid strands and heaps having carcinomatous characteristics.

CASE 13. von Eiselsberg (13). A man, aged 72, 6 years previously had received a blow on the sternum, followed by a hard tumor which reached egg size. Extirpation was followed by death. Microscopically it consisted of vascular tissue with some cystic colloid formation.

The thyroid gland was slightly enlarged. In the left lobe were some hard nodules. The left lobe showed the structure of colloid goiter.

CASE 14. von Eiselsberg (14). A man, aged 38, had a fist-sized tumor in the midline between the parietal bones, with many dilated vessels. The tumor enlarged when he bent over. It was diagnosed as sarcoma, and extirpated. It was found to be adherent to the dura. Microscopically it was a typical adenoma of the thyroid with some colloid development. There was a recurrence 4 years later. The patient was alive 8 years after operation.

The patient had had a goiter since the age of 20 years. There was no enlargement during the postoperative period of observation. *No microscopic examination. No autopsy.*

CASE 15. Emmerich (15) reports the case of a man, aged 63, with metastases to the sternum, spine, and pelvis. Microscopically the tissue was normal thyroid.

CASE 16. Ewald (16). A woman, aged 45, had pain in the angle of the right scapula. A tumor appeared, reaching fist size in a year. The diagnosis was metastatic goiter. The tumor of the scapula, when extirpated, measured 11 by 6 centimeters. It was yellow-brown, cystic, nodular. Microscopically there were many follicles covered by simple columnar epithelium and filled with colloid. There were atypical proliferating cell masses, as in adenocarcinoma of the thyroid gland.

A goiter of 4 years' duration reached orange size and was removed 1 year previously. A nodule then appeared in the right lobe and was extirpated. Some infiltration aroused suspicion of malignancy. The structure was that of simple colloid goiter. *No autopsy.*

CASE 17. Fabris (17). Woman, aged 37. Symptoms of compression of the spinal cord first appeared 1 year before death. There was a soft, reddish, elastic tumor of the body of the third dorsal vertebra of hen's egg size with compression myelitis. Death was from bronchopneumonia. Histologically the tumor was thyroid tissue, partly colloid, partly parenchymatous, with vascular connective tissue. There was complete absorption of bone. The follicles did not possess the histological characteristics of malignancy.

There was an old unilateral goiter without adherence to the neighboring tissues. Histologically, it presented all the characters of benign thyroid adenoma. It was impossible to find any indication of malignant degeneration.

CASE 18. Feurer (18). A woman, aged 58, within 1 year following trauma, developed a large, fist-sized pulsating tumor over the left parietal bone which penetrated the skull. It was diagnosed sarcoma, and partially extirpated. Bleeding was profuse. Recurrence was followed by death 10 months after operation. Microscopically the tissue was identical with that of colloid goiter.

The patient had a small, fist-sized goiter. Microscopically it was a simple colloid goiter. *No autopsy.*

CASE 19. Flatau and Koehlichen (19). A girl, 17 years of age, 1 month previously had had vertigo, vomiting, Romberg's sign, visual impairment, and headache. The reflexes were normal. A diagnosis was made of cerebellar tumor. In the right occipito-temporal region was a small, soft, tumor mass, distinctly pulsatile, with bruit. Death occurred in 4½ months. *Autopsy.* The tumor had eroded the bone below the external occipital protuberance. There was compression of the cerebral convolutions, and invasion of the right cerebellar hemisphere. Microscopically, the tumor showed alveolar structure rich in colloid, abundant connective tissue, and numerous mitotic figures.

The thyroid gland was enlarged, especially the right lobe which contained a firm encapsulated nodule. Histologically, it presented the aspect of normal thyroid tissue: alveoli filled with colloid and covered with a layer of flattened cells.

CASE 20. Foerster (20). A woman, aged 49, showed signs of compression myelitis due to a pulsating vertebral tumor, simulating aneurism. Cystitis, a large decubitus, and septic fever developed, followed by death. *Autopsy.* Metastasis replaced the sixth thoracic vertebra, compressing the spinal cord. There was a metastasis in the sixth left rib the size of a child's fist. There were metastases to the third, fourth, and fifth thoracic vertebræ, and multiple pulmonary metastases. Microscopically, there were many areas resembling normal thyroid tissue. Other areas resembled adenocarcinoma with ability to form rich colloid.

The patient had a medium-sized goiter. The nodules in the right thyroid lobe became smaller prior to death and became intensely hard. There was no infiltration. *No microscopic examination* was made.

CASE 21. Gierke (21). A man, aged 57, experienced 4 years previously radiating pains in the hip joint, with hæmaturia. A diagnosis of renal calculus was made. For 2 years there had been a stinging sensation in the right fifth intercostal space, then pains in the sixth and seventh interspaces. Finally there was a girdle sensation around the chest, and spastic paraplegia of both lower extremities with cramping pains in the lower trunk. The abdominal muscles became paralyzed, and there was anæsthesia of the lower half of the body. Ankle clonus developed, but there was no vertebral deformity. A large sacral decubitus with septicæmia led to death. A clinical diagnosis was made of myelitis transversalis dorsalis of unknown etiology.

Autopsy. On the right side of the fifth dorsal vertebra and rib was a saucer-sized tumor infiltrating the muscle, which grossly resembled goiter. It extended into the spinal canal and compressed the cord. In the first lumbar vertebra, a tumor the size of a hazel-nut extended into the spinal canal. In the right posterior thorax in the mid-axillary line, a tumor the size of a fist extended from the fourth to the sixth rib. The ribs were invaded, and the tumor was continuous with the vertebral tumor. The fifth and sixth thoracic vertebræ were destroyed by the tumor. The gross pathological diagnosis was primary vertebral sarcoma. Microscopically, the center showed large colloid-filled follicles—areas suggesting parenchymatous goiter, but no areas suggesting carcinoma. The periphery showed many proliferating cell masses. There was muscle infiltration. The lumbar metastasis was similar.

The thyroid gland was slightly enlarged and grossly rich in colloid. In the right lower pole was a pea-size nodule, with hyalinization and calcification, similar to benign adenoma. Microscopically, the thyroid nodule showed small solid follicles similar to fetal adenoma. There were no tumor-thrombi. The capsule was intact, and there was no lymph node invasion.

CASE 22. Gierke (22). A man, aged 46, had stinging pains in the sacrum for 4 years. A clinical diagnosis of compression myelitis of 1½ years' duration was made. At the level of the third dorsal vertebra, kyphosis developed. In the first lumbar vertebra was a tumor the size of a fist of 2 years' duration. Microscopically, the picture was that of colloid goiter with colloid more compact than in the previous case. From 3 to 5 milligrams of calcium iodide were found in 20 grams of tumor.

The thyroid gland presented a normal appearance. *No microscopic examination* was made.

CASE 23. Goebel (23). A woman, aged 54, fell 2½ years previously and fractured the femur which healed with shortening. Three months later she fell again and the femur fractured spontaneously. No consolidation followed. At operation a mass was found in the bone which infiltrated the muscle. It was diagnosed sarcoma. Microscopically it was a thyroid adenoma, "with polymorphism of cell cords, and solid epithelial nests." An area of thyroid metastasis was found in the bone marrow at a lower level.

The patient had a goiter of moderate size. *No microscopic examination and no autopsy* was made.

CASE 24. Guibé and Legueu (24). A woman, aged 51, complained of pains in the right shoulder. A pulsatile tumor the size of a chicken's egg was in the outer third of the right clavicle. It was extirpated. Sixteen months later there was no recurrence. Microscopically it simulated thyroid structure with abundant homogeneous material giving color reactions of colloid.

The thyroid gland showed no enlargement and no signs of malignancy. *No microscopic examination. No autopsy.*

CASE 25. Gussenbauer (25) reports the case of a woman with a soft and fluctuant mass in the region of the tenth, eleventh, and twelfth thoracic vertebræ. There were pains in the lower extremities, and finally paraplegia. Kyphoscoliosis developed. Local recurrence followed operation. Microscopically, it was a typical thyroid adenoma.

The thyroid gland was large, particularly on the left. It was clincially benign. *No microscopic examination. No autopsy.*

CASE 26. Halbron (26). A woman, aged 68, had a tumor of the sternum, 8 by 10 centimeters, with expansive pulsations, synchronous with the radial pulse. A diagnosis was made of aneurism of the ascending aorta. Death occurred 3 years after onset. *Autopsy.* There was no connection between the thyroid and sternal tumor. The tumor involved the right sternoclavicular articulation and clavicle. Microscopically there were many vesicles filled with colloid and surrounded by flattened cells. There were other areas of large, irregular cells, irregularly infiltrating neighboring tissues.

The patient had had a soft goiter of fist size for 4 years. Microscopically it presented the classical aspect of benign goiter throughout.

CASE 27. Halpérine (27). A man, aged 54, had a small tumor of the clavicle of 20 years' duration. He was in good health. Following traumatism, the clavicular tumor grew rapidly to the size of a small fist, and was extirpated. Microscopically, the structure was that of thyroid.

The patient had a goiter which was larger on the right. *No microscopic examination. No autopsy.*

CASE 28. Harmer (28). In a woman, 44 years of age, a tumor slightly larger than a nut appeared on the right side of the face 2½ years previously, with no marked increase in size. She complained of headache and nasal obstruction, and lid ptosis. There was decreased visual acuity in the left eye, then the right; and bilateral optic atrophy. In front of the left nares was a hard, reddish-gray, cherry-sized movable tumor; on the right was a flat tumor, reddish-gray and soft. The right choana was filled with a polypoid mass. Extirpation was followed by recurrence. Microscopically there were masses of cubical and polymorphous epithelial cells arranged in alveoli, surrounding colloid masses.

A goiter slowly developed at the time the sphenoid tumor appeared, and later rapidly increased to the size of a man's fist. There were palpable glands behind the thyroid. There were no difficulties in breathing or swallowing resulting from the thyroid enlargement. *No microscopic examination. No autopsy.*

CASE 29. Haward (29). A woman, 59 years of age, had on the vertex of the skull, a firm, elastic, orange-size tumor of 7 months' duration. At the external border of the left scapula was a soft, round, smooth tumor, 3 inches in diameter. There was a similar pulsating tumor of the left ilium. Anæsthesia and paræsthesia were present below the seventh rib. Death occurred 1 year after the onset of symptoms. *Autopsy.* The cranial tumor rested on the dura. On the posterior surface of the seventh cervical vertebra, a similar growth projected into the canal and exerted pressure on the spinal cord. Metastases were found in the liver, spleen, and kidney, and all showed alveoli; many were filled with colloid, and were covered by a single layer of cubical cells resembling normal elements of thyroid gland.

The thyroid gland had recently enlarged after 21 years of quiescence. At autopsy, a firm tumor was found compressing the trachea, which resembled ordinary goiter.

CASE 30. Helbing (30). In a woman, 51 years of age, a tumor the size of a hazel-nut had appeared in the manubrium sterni 17 years previously. It was noticeable long before the thyroid enlargement appeared. Seven years previously it had reached the size of an apple, with lively pulsations, and was compressible. A diagnosis was made of aortic aneurism. For 3 years she had had pains in the back and sacrum terminating in weakness and stiffness of both legs, and urinary and fæcal incontinence. While she was lying in bed the upper right femur had fractured spontaneously. A fusiform swelling appeared at the point of solution of continuity. The sternal tumor reached fist size. She died of ascending infection of the urinary tract. *Autopsy.* The sternal tumor resembled grossly the goitrous thyroid. A tumor the size of a dove's egg was found in the seventh thoracic vertebra, compressing the spinal cord. In the region of the pathological fracture was a raspberry-jelly-

like mass. Microscopically, all the tumors showed goiter tissue without signs of malignant degeneration.

The right thyroid lobe became enlarged to apple size. At autopsy the thyroid was found completely encapsulated with right-sided goiter. Microscopically, the tissue was simple goiter without evidence of malignancy.

*Case 31. Heschl-Wolfler (31). A man, aged 35, had metastatic nodules in the lung, the structure being that of thyroid vesicles.

There was a tumor of the thyroid the size of an infant's head. Extirpation was followed by recurrence 2 years later. At the second intervention, death followed 3 days after operation. *Autopsy.* Microscopically, the tissue from the first operation was thyroid adenoma (Heschl); from the recurrence, intermediate forms between adenoma and alveolar cancer, some areas being typically alveolar.

Case 32. Hinterstoisser (32). A man, 38 years of age, had symptoms of chronic meningitis. At autopsy, a large tumor was found involving the base of the skull and the entire sphenoid bone. Microscopically, this was an adenocarcinoma of thyroid origin with many large follicles and marked colloid development like that seen in normal thyroid tissue. There were multiple pulmonary metastases.

Only the left side of the thyroid gland was enlarged. It contained adenomatous masses.

Case 33. Hinterstoisser (33) reports another case in which there were multiple metastases to the vertebræ, ribs, ilium, and lungs; all colloidal in type. There were also metastases to the skull, adenocarcinomatous in type.

In the enlarged lobes of the thyroid were many colloid nodules.

Case 34. von Hofmann, E., from Delannoy and Dhalluin (34). A woman, 43 years of age, had a rapidly growing tumor of the scapula which appeared 9 months after ablation of the thyroid nodule. It was extirpated but recurred in 2 years. There was a second intervention. Death occurred 2 years later without recurrence. Microscopically the first tumor was adenocarcinoma.

The patient had had goiter for 4 years. The nodule from the right lobe was extirpated 9 months before the scapular tumor appeared. Microscopically, the image was that of colloid goiter without malignant characteristics. *No autopsy.* An *incomplete microscopic examination* was made.

Case 35. Hollis (35). A man, aged 45, complained of severe headache, dizziness, and vomiting, of 9 months' duration; and finally, paralysis of the lower extremities and anæsthesia below the costal margin and the tenth dorsal vertebra, and incontinence. The Babinski reflex was present. A large, deep-seated, rapidly growing tumor appeared behind the left clavicle and sternomastoid, which diminished in size. (Malignancy of accessory thyroid?) At autopsy, a walnut-sized tumor was found beneath the cerebral membrances to the left of the falx cerebri with compression of the brain. Similar tumors were found on the left side of the cerebellum and in the body of the third dorsal vertebra, with pressure on the cord. There were metastases in the liver and adrenals. Microscopically, the thyroid tumors showed areas of malignant growth, especially those in the adrenals.

There was no enlargement of the thyroid. *No gross or microscopic examination* was made. The mass behind the left clavicle and the sternomastoid may well have been a carcinomatous accessory thyroid.

Case 36. Honsell (36). Woman, aged 20. In the frontal bone was a very slow growth the size of a pigeon's egg, extending to the dura. The microscopic appearance was that of colloid goiter without signs of malignancy. A cystic tumor had been removed from the same region 7 years previously.

A partial thyroidectomy of a fist-sized left lobe was performed 2 years before the second appearance of the frontal tumor. There was considerable growth of the goiter in the interim. Microscopically, the structure was that of colloid goiter with "solid round or filiform islands of epithelium characteristic of rapidly proliferating cells. Occasional solid epithelial strands at periphery of tumor." *No autopsy.*

*Case 37. Huguenin (37). A man, 58 years of age, had severe pains in the back which began 1 year previously. Later, there developed pains in the legs, stiffness, weakness, and inability to move the legs actively. In an angular curvature in the middle of the back a soft, fluctuating, painless tumor was felt. Its presence was unknown to the patient. The patellar reflexes were exaggerated. Sensation was diminished below the umbilicus, with uninary and fæcal retention. There was a bilateral Babinski reflex, with sacral decubitus and suppuration. Death. *Autopsy.* The tumor involved the sixth, seventh, and eighth dorsal vertebræ, and simulated an acute swelling of the spleen. The mass encroached on the spinal cord. Microscopically, the sixth vertebra showed solid cell strands with polygonal, round, and spindle forms; the seventh showed the picture of thyroid gland of adult with many follicles filled with colloid and surrounded by a single layer of cubical and cylindrical epithelial cells.

At autopsy both lobes of the thyroid gland were somewhat enlarged, the left (6 centimeters) more than the right (5 centimeters). The lower pole of the right lobe was intrathoracic. The capsule was intact. Microscopically, throughout, the picture was that of parenchymatous colloid goiter. After repeated searches, a small, whitish nodule (4 by 5 millimeters) was found in the lower pole of the left lobe. This area was definitely carcinomatous, showing anastomosing cords of round and oval hyperchromatic cells.

Case 38. Hutchinson (38). A woman, 50 years of age, had "rheumatic" pains in the left shoulder for 5 months following a fall. The swelling appeared in the upper third of the arm. At exploratory incision a small growth was found near the deltoid insertion. During operation, the humerus fractured spontaneously. Amputation was followed by healing, with death in 6 months. Cachexia was marked. Microscopically, the picture suggested metastases of thyroid tissue as in Morris's case.

The thyroid gland was *not examined*, and there was *no autopsy.*

Case 39. Jaboulay (39). A man, 60 years of age, had a tumor of the clavicle near the sternoclavicular articulation which had developed at the same time the goiter appeared. It was as large as the two neck tumors combined, and was firmly adherent to the bone, with crepitation on movement. At extirpation, several small encapsulated thyroid masses were found behind the clavicle. *No histological examination* was made.

The patient had had a slight goiter for 2 years, with more rapid growth during the past 14 months. It consisted of 2 masses in juxtaposition, each the size of a tangerine. There were no signs of compression or Basedowism, and no infiltration of the neck structures. It was clinically benign. Operation followed extirpation of the clavicular tumor, when neoplastic infiltration of the trachea was found. *No histological examination. No autopsy.*

Case 40. Jacobaeus (40). A man, 40 years of age, 1 year previously experienced loss of sensation in the abdomen and hip, twitching of right leg, and girdle pains around the abdomen. Babinski's sign was present, with kyphosis of the second and third thoracic vertebræ. The X-rays showed destruction of the third thoracic vertebra. The clinical diagnosis following extirpation of the thyroid

nodule was "tumor vertebræ dorsalis (metastasis strumæ benignæ) cum compressione medullæ spinalis." Laminectomy was done. Microscopically, epithelial proliferation was associated with areas of colloid and atypical gland cells—more malignant than the extirpated goiter nodule.

Thirteen years previously, a goiter the size of a fist was removed surgically. The thyroid now contained a walnut-sized, hard nodule, which was extirpated. Microscopically, it was a follicular goiter with rich proliferation of follicles, partly with solid strand formation. Colloid was scant, and there were many atypical cells. *No microscopic examination* was made *of tissue from the first operation. No autopsy.*

CASE 41. Jaeger (41). In a woman, 69 years of age, following a fall, a tumor developed in the sixth and seventh cervical and first thoracic vertebræ. Another tumor involved the third and fourth lumbar vertebræ. At operation on the lumbar tumor there was profuse hæmorrhage. Microscopically, the structure was that of benign adenoma.

The patient had had a freely movable goiter for 10 years. *No microscopic examination. No autopsy.*

CASE 42. Jeffries (42) reports the case of a parietal subdural tumor composed of somewhat embryonal thyroid tissue.

The thyroid gland appeared to be entirely normal. *No microscopic examination. No autopsy.*

CASE 43. Joll (43). A woman, 47 years of age, had pain and weakness in the left arm and a tumor of the sternal end of the left clavicle. Healing followed extirpation. Microscopically, "appearance of innocent goiter; the vesicles are of regular shape, and most of them contain colloid."

The thyroid gland had escaped attention until the nature of the clavicular tumor was discovered. There was a small, firm, freely movable tumor of the right lobe. *No microscopic examination. No autopsy.*

CASE 44. Kanoky (44). In a woman, 40 years of age, a tumor the size of a hazel-nut had appeared 3 years previously on the left side of the head. Three months later, it had reached 1 inch in diameter. Attempted surgical removal resulted in profuse hæmorrhage. The tumor was not removed. The growth gradually increased for 2 years without symptoms, then pain, nausea, vomiting, epistaxis, and transient paralysis of the left arm and leg developed. There was marked left exophthalmos with blindness. The left common carotid artery was ligated. The pulsations stopped and the tumor diminished in size. There was complete right-sided hemiplegia 6 hours after operation, with death 36 hours after operation. Postmortem, a tumor, 5 by 3 by 2½ inches, was removed. The bone was completely absorbed, and the tumor extended to the dura. Macroscopically, it was like thyroid; microscopically, "structurally identical with normal thyroid tissue; no trace of malignancy."

An enlargement of the right side of the neck began 20 years previously. It grew to large size during the next 10 years; and was treated with injections (phenol and iodine?). Two years later, the right lobe was extirpated (intrathoracically). *No microscopic examination. No general autopsy.*

CASE 45. Knapp (45). A man, 66 years of age, complained of vertigo and diplopia. There was a pulsating, soft tumor within the right upper orbital margin about ¾ inch in diameter. At operation it was found to extend to the dura. Microscopically, it was (Ewing) "adenoma of aberrant thyroid tissue." There was a recurrence, a tumor 5 centimeters in diameter, in the right scapula. The X-ray showed multiple nodules in the lungs, and destructive processes in the eighth rib and pubis. He died 3½ years after onset.

The thyroid gland seemed entirely normal. Later, a circumscribed firm tumor appeared in the lower left lobe (4 centimeters in diameter). *No microscopic examination. No autopsy.*

CASE 46. Kolb (46). A woman, 75 years of age, had a small tumor in the left parietal region which had developed 6 years after the extirpation of the goiter. It was a progressive growth, vascular, simulating hæmangioma. There were no pulsations, and no bruit. The clinical and radiological diagnosis was sarcoma. At extirpation it was found to extend to the dura, a portion of which was removed with the adherent tumor. Death followed operation. *Autopsy.* There was a defect in the skull the size of a saucer. There were a few whitish pea-sized nodules in the lungs. Microscopically, the nodules in the lungs showed typical goiter structure. The parietal tumor was of the same architecture as the thyroid.

A goiter had been removed 7 years previously. It was normal in size at the time of autopsy; the right side being somewhat larger. Microscopically, there were large follicles with no malignant changes.

CASE 47. Kraske (47). In a woman, 53 years of age, a small vascular tumor of the forehead appeared 6 weeks following trauma, and extended through the frontal bone to the dura. It was removed at operation and there was no recurrence during 3 years. Microscopically, it was normal thyroid tissue.

A large goiter remained unchanged during the 3 years following operation. *No microscopic examination. No autopsy.*

CASE 48. Langhans (48). Male, 38 years of age. *Autopsy.* There were thyroid nodules; and metastases of similar appearance in bronchial, mediastinal, and retroperitoneal lymph nodes, lungs, kidneys, vertebræ, sternum, and ribs. The metastases in the lymph nodes showed the same histological structure as the thyroid nodules: colloid masses surrounded by cubical and sometimes cylindrical epithelium. Lung and pleura and kidney nodules showed the same structure.

There was a small cyst of the right thyroid lobe filled with hæmorrhagic colloid fluid, with several small nodules in the slightly enlarged left lobe. Microscopically, the nodules contained vesicles of various sizes and forms, the smaller ones surrounded by cubical epithelium and usually empty, while the larger ones contained a pale colloid. The thickness of the epithelium pointed to a lively recent enlargement, which presented the picture of colloid goiter.

CASE 49. Langhans (49). *Autopsy* on a woman, 67 years of age, revealed an anterior mediastinal node, enlarged to 2 to 3 centimeters in diameter, hard, grayish-white and grayish-red, fairly transparent. There were many similar nodules in the lungs, bronchial glands, and choroid plexus. There was complete imitation of normal thyroid tissue in many of the secondary nodules. All showed structure of simple benign goiter. Some small vesicles without lumina or colloid appeared as solid cell heaps. There was no tumor thrombosis or infiltration of the stroma. In one lymph gland were indifferently formed solid cell nests of carcinomatous appearance. Numerous lung nodules were more carcinomatous, with solid cell strands and nests, together with numerous vesicles of 100μ diameter, simulating normal thyroid vesicles. The choroid plexus nodules were similar to those in the lungs.

Both lobes of the thyroid gland were enlarged, each containing several colloid nodules showing calcification. Grossly it was a simple goiter. Microscopically, large and small vesicles were found filled with shining colloid, surrounded by cubical and flattened epithelium.

CASE 50. Leclerc and Masson (50). A man, 67 years of age, had had sciatica for 7 years. A tumor mass, the size of 2 adult fists, in the left costo-iliac region, extended from the ninth rib to the iliac crest and into the pleural cavity

with no adherence to the skin. It was thought to be sarcomatous and was extirpated. Microscopically, it was intermediate in form between fetal adenoma and colloid adenoma, with *more numerous mitotic figures than those ordinarily seen in thyroid adenomata.* Following operation, there were lancinating pains in the left thigh, then paraplegia of the lower extremities, urinary and fæcal incontinence, anæsthesia below the umbilicus (vertebral metastases), with death 2 months after operation.

There was a small tumor of the thyroid gland under the left sternomastoid, rising with the larynx upon deglutition, which was firm, uniform in consistency, smooth, and not adherent. It had appeared a few months previously, with no increase in volume. There was no clinical evidence of malignancy. *No microscopic examination. No autopsy.*

CASE 51. Litten (51) reports the case of an adenoma gelatinosum in the femur, lumbar vertebræ, and pelvis, with malignant appearing metastases to the lungs and bronchial lymph nodes. The patient had a gelatinous goiter.

CASE 52. Meyer (52). A woman, 58 years of age, had a smooth, painless tumor of the right temporal and parietal region which grew to 10 centimeters in diameter in 15 months. Recently, the growth had been more rapid. The right thigh had fractured spontaneously, with non-union. The tumor of the cranium grew slowly and produced right exophthalmos. A bruit could be heard over it. Death occurred 2 years and 8 months after onset. *Autopsy.* There were metastases also to the bronchial and inguinal nodes and the lung. Microscopically, the skull tumor showed for the most part typical thyroid vesicles with colloid content, resembling normal thyroid. The bronchial nodules resembled atypical cells of the middle thyroid lobe. The inguinal nodes showed normal appearing thyroid tissue and small vesicles without colloid. The femoral tumor was made up of small colloid-free vesicles. Tests for iodine were negative.

The thyroid gland was enlarged mostly on the left (8 centimeters in diameter). At autopsy the left lobe was moderately enlarged, but extended into an orange-sized tumor just above the left clavicle. The right lobe was of walnut size. The middle lobe was enlarged and whitish. Microscopically, the middle and left lobes showed small vesicles, surrounded by atypically arranged cell heaps. Some parts contained normal colloid. It suggested transformation of adenoma into carcinoma.

CASE 53. Middeldorpf (53). A woman, 56 years of age, had a fluctuating large tumor of the left thigh of 1¼ years' duration, with radiating pains in the foot and leg. Later a painful tumor of the occiput appeared and was partially extirpated. Microscopically, the structure was that of thyroid adenoma. Eight months after operation, spontaneous fracture of both thighs occurred, and later, fracture of both arms. The patient died 3 years after the onset with marked marasmus. At *autopsy*, multiple small nodules were found in the lungs, a fist-sized occipital tumor penetrated the dura mater. There were other nodules in the lumbar vertebræ, sacrum, pelvis, femora, and humeri. Microscopically, all showed the structure of benign thyroid adenoma.

In the left lobe of the thyroid gland was a small nodule the size of a pigeon's egg, freely movable, whose duration was unknown. It had not become augmented at any time. Histopathologically, it was a benign thyroid adenoma, *but the cells of one had penetrated the capsule.*

*CASE 54. Mignon and Bellot (54). A man, 68 years of age, had a pulsating tumor of the dorsolumbar spine which appeared after an injury, and grew steadily for 3 years to the size of a large egg. There were lancinating pains in the thighs and buttocks. At operation, the spinous process and lamina of the twelfth dorsal vertebra were found entirely replaced by soft vascular tissue. Clinical improvement was followed by recurrence in 14 months, with lancinating pains and trophic ulcers. A soft, red, friable mass, 4 fingers' breadth by 5 centimeters, infiltrated the muscle. Death occurred 3 days after operation. Microscopically the mass resembled normal thyroid in part. Other areas were distinctly atypical.

The thyroid gland was moderately enlarged, but had been disregarded during physical examination. There had been no change in volume for 13 months. Postmortem, a small nodule of hazel-nut size was found in the left lobe, which gave a typical microscopical appearance of thyroid carcinoma. There was a *partial autopsy only.*

CASE 55. Morris (55). A woman, 40 years of age, had a large pulsating tumor of the left parietal region, 6½ by 7 inches. It had appeared 2 years previously following mild traumatism. She died 6 years after the onset. Partial autopsy showed a skull defect 1¼ inches in diameter. The tumor rested on the dura. Microscopical examination of the parietal tumor showed a structure similar to thyroid gland: colloid containing "cysts" surrounded by flattened cells.

There was some diffuse swelling of the thyroid. *No microscopic examination. Partial autopsy only.*

CASE 56. Muzio (56). A woman, 48 years of age, had a tumor in the right gluteal region which developed rapidly following trauma. In 2 years it had reached the size of an orange, and was extirpated. Microscopically it was colloid goiter.

The thyroid gland had been moderately enlarged for 10 years. *No microscopic examination* and *no autopsy* was performed.

*CASE 57. Neumann (57). A woman, 54 years of age, had an apple-sized, elastic tumor of the right arm, just above the humeral condyles. The overlying skin was red and infiltrated, there were no pulsations, and the forearm was atrophied. There was abnormal mobility and crepitation of the humerus just above the elbow. A diagnosis was made of sarcoma with spontaneous fracture. Amputation was done and the patient died 14 days after operation of gangrene of the wound. Microscopically the tissue simulated the appearance of normal thyroid parenchyma, spherical acini, rich in colloid, covered with simple cubical epithelium.

Postmortem, a solid nodule the size of a goose egg was removed from the left lobe of the thyroid gland. It had a hard fibrous capsule, with calcification and cysts. Microscopically, there were large follicles surrounded by flat epithelium and filled with colloid; normal thyroid tissue for the most part; and compact nests of rapidly growing cells in the connective tissue, with tendency to form a single layer. *No complete autopsy.*

CASE 58. Oderfeld and Steinhaus (58). A woman, 58 years of age, had an egg-sized elastic tumor of the left frontal bone, replacing bone, which had appeared 3 months previously. The growth was slow at first, then rapid. The patient had had headache only during the last 2 weeks. The diagnosis was sarcoma. At operation a yellow-brown vascular tumor was found extending to the dura. Convalescence was uneventful. Six months later (November, 1900) there was no recurrence, and the patient was in good condition. Microscopical examination showed alveolar structure, with simple low columnar epithelium, enclosing homogeneous colloid mass. The tumor was identical with normal thyroid tissue.

The thyroid gland was not enlarged, and there were no accessory thyroids. *No microscopic examination* was made.

One-half year later (June, 1901) there was a recurrence the size of a chicken's egg in the left frontal bone. Simultaneously, there appeared an apple-sized tumor in the right temporal bone, and a walnut-sized tumor at the right sternoclavicular junction. The patient was markedly emaciated. Death followed the removal of the temporal metastasis. Incomplete autopsy (upper sternum, left clavicle, trachea, thyroid gland, and frontal recurrence) showed, microscopically, a recurrence; and the sternoclavicular nodule showed normal thyroid tissue.

The right lobe of the thyroid gland became enlarged as the recurrence and temporal tumor appeared. On section of the right thyroid, a spherical nodule was found encapsulated. This nodule was recognized as the primary tumor, anatomically. Histologically it resembled thyroid tissue. *No complete autopsy.*

CASE 59. Patel (59). A woman, 65 years of age, had a tumor of the left frontal bone (orbital margin) of 4 months' duration. It was expansile, synchronous with the pulse. At extirpation it was found to rest on the meninges, and to perforate completely the frontal bone. Microscopically, there were areas reproducing normal thyroid and other areas showing the character of a thyroid carcinoma of high malignancy. There was a recurrence 8 months later.

For 30 years there had been a tumefaction of the thyroid gland, with no recent augmented growth, and no signs of malignancy. The tumor was uniformly hard, mobile, and painless. *No histological examination* was made and *no autopsy* performed.

CASE 60. Porcile (60). A woman, 46 years of age, had a slowly developing tumor involving the inner third of the clavicle, sternoclavicular articulation, and manubrium sterni, with pains in the left arm. Extirpation revealed a grossly irregular, spherical mass with a firm gray peripheral zone and a soft central zone. Microscopically, follicles were surrounded by cubical and columnar cells, and contained homogeneous colloid. Some areas showed the structure of adenoma, others were carcinomatous. Paraplegia was followed by death. There was a metastasis also to the seventh dorsal vertebra.

In the thyroid gland was a walnut-sized tumor, firm, painless, not adherent to the skin. The patient experienced no difficulties in respiration or deglutition. *No microscopic examination* was made and *no autopsy* performed.

CASE 61. Poser (61). A woman, 42 years of age, soon after thyroidectomy, 6 years before examination, developed weakness of the left leg, followed by paræsthesia. There was a feeling of pressure in the abdomen, with pains in the right leg. A soft irregular swelling appeared at the right posterior iliac spine. At operation, a soft, grayish, red tissue was found extending from the lumbar vertebræ. Paræsthesia disappeared only to reappear a few days later. Six months later, a hand-size pulsating tumor appeared in the sacral region, with rapid recent growth. The patient was bedridden and cachectic. Microscopically, the lumbar tumor showed long parallel strands with colloid deposit and large vesicles filled with colloid and surrounded by flattened epithelial cells.

Twenty years previously a small goiter had developed and had remained uniform for 14 years, after which it grew rapidly and caused marked difficulty in swallowing. At operation all of it was removed except a portion of the left lobe. Microscopically it was a parenchymatous colloid goiter. At the time the case was reported the thyroid contained a nodule the size of a walnut in the midline, with no fixation to the skin or the underlying tissues.

CASE 62. Radley and Duggan (62). The patient was a man, 46 years of age. A small nodule had appeared in the right clavicle 6 months previously, and grew to orange size; was smooth, tense, and showed visible pulsations. A reddish-brown, vascular, soft tumor was excised. Histologically it was a secondary thyroid carcinoma, with both solid and tubular acini. Tests for iodine were negative.

Two years before, a small adenoma had been shelled out of the thyroid isthmus. It was normal in size, consistency, and mobility, with no evidence of malignancy. *No histological examination. No autopsy.*

CASE 63. Regensburger (63). A woman, 55 years of age, had had a painful swelling in the left upper arm 2 years previously, which had gradually increased to the size of a man's fist. In the infraclavicular fossa were 2 hard glands of hazel-nut size. The patient showed marked cachexia. A diagnosis of sarcoma was made. The upper third of the humerus was resected and the infraclavicular glands removed. Healing resulted. The tumor of the humerus, 9 by 6 centimeters, infiltrated the bone irregularly. The lymph nodes were replaced by whitish growth. Microscopical examination showed bone tumor and lymph glands. There were large epithelial cell masses, some forming longitudinal rows. Many acini showed typical thyroid structure. Many papillæ were covered with large cylindrical cells. The lymph nodes were similar. Chemical analysis showed no iodine.

In the middle lobe of the thyroid was a hard tumor the size of a prune. *No microscopic examination. No autopsy.*

CASE 64. Reinhardt (64). A woman, 52 years of age, for 6 months had had pains in the right scapula, radiating to the left arm. Later, sudden paralysis of the lower extremities appeared. Laminectomy of the second to the fourth thoracic vertebræ was done. On both sides of the midline were hazel-nut-sized tumors of the vertebræ. Extirpation resulted in death during operation. Microscopically the tissue was simple benign parenchymatous goiter.

The patient had a large goiter, with no growth for years. Clinically it was non-malignant. *No microscopic examination. No autopsy.*

CASE 65. Riedel (65). The patient was a woman, 40 years of age. Thyroid tissue was removed from the jaw, with recurrence 10 years later.

There was no growth of the thyroid gland at the time of operation or during the 10-year interval. *No microscopic examination. No autopsy.*

CASE 66. Riedel and Haeckel (66). A woman, aged 48, had a deep-seated, rapidly developing tumor mass in the midline of the maxilla. Hemiresection of the jaw was done. Microscopically the tissue was typical thyroid. There was no recurrence 4 years later.

The patient had a large goiter at the same time, which had been present for 20 years. *No microscopical examination. No autopsy.*

CASE 67. Runge (67). A woman, 41 years of age, 3¼ years before had felt a sudden "cracking" in the back of the neck, accompanied by stinging pain. Rotation was limited; the head fell to one side; and flexion and extension were later limited. Active motion of the head was impossible. Simultaneously the right arm and leg became paralyzed. Later the left arm became paralyzed. A diagnosis was made of compression myelitis due to caries or tumor of the epistropheus. The patient died in the seventh month of pregnancy. Successful postmortem and cæsarean section was done. *Autopsy.* There was a reddish tumor of the occiput around the foramen magnum, atlas, and epistropheus. The main mass in the spinal canal originated in the epistropheus and infiltrated the muscle. Microscopically, (von Recklinghausen) nests and strands of cells were spherically disposed in alveoli. Many were colloid-containing with a single layer of flattened cells as in thyroid gland. (This was regarded by Cohnheim as similar to his case.)

This patient's neck was much deformed, especially on the right, with no enlargement of the cervical nodes. Swallowing of solid substances became difficult. At autopsy, the thyroid was found much enlarged with many encapsulated adenomata. Microscopically there was no indication of malignancy.

CASE 68. Schmidt (68). A woman, 57 years of age, for 3 years had had a tumor the size of a hazel-nut at the lateral aspect of the left clavicle, with recent accelerated growth. The regional lymph nodes were not enlarged. The growth was extirpated. Microscopically the appearance was that of benign goiter. After several searches, a carcinomatous infiltration of the capsule was found. Death followed a few weeks after operation.

The thyroid glands were clinically normal in appearance. *No microscopic examination* and *no autopsy* was made.

CASE 69. Schrager (69). In this case a periureteral thyroid metastasis was found at operation for ureteral stricture. It was thought to be a benign metastasis. Microscopically it was typical thyroid tissue.

No abnormalities of the thyroid gland were mentioned. *No histological examination. No autopsy.*

CASE 70. Gavel (70). A man, about 40 years of age, had been subjected to a previous operation on the pelvis for sarcoma. A recurrence was treated with Coley's toxins, with no effect on the size of the tumor. Death was from exhaustion. The tumor involved the left greater trochanter of the femur and the left and right sacro-iliac synchondroses. The tumor was pulsatile and compressed the bladder and rectum, with ulceration of the overlying skin. Microscopically, the tumor was typical thyroid tissue with alveoli filled with colloid.

No symptoms were referable to the neck. *No examination of the thyroid* was made.

CASE 71. Walther (71). A woman, 49 years of age, had an occipital tumor which was diagnosed sebaceous cyst. Extirpation was followed by recurrence and a second operation. A tumor 5 centimeters in diameter was found implanted in the occipital region, attached by a pedicle to the dura mater. Microscopically, the tumor was characteristic thyroid tissue.

The thyroid gland in the right lobe was hard and irregular. There was another large tumor in the left sternomastoid region, apparently independent of the thyroid. These growths were *not removed. No microscopic examination* was made and the *outcome* was *unknown.*

CASE 72. Wilkens and Hedren (72). The patient was a woman, 72 years of age. Seven years previously, tumors had appeared in the temporal region and on the summit of the cranium, which grew to the size of an adult head; soft, fluctuant, pulsatile. The only subjective symptoms were a buzzing in the ears and a slightly obscure vision. Cachexia was followed by death. A diagnosis was made of vascular osseous tumor. *Autopsy.* Cranial tumors had developed in the bone. On section, they were grayish-white with ecchymotic spots. A similar tumor was in the second, third, and fourth dorsal vertebræ. Microscopically, the tissue was embryonic thyroid with polymorphous cellular elements rich in chromatin. The appearance was that of carcinoma.

A recent augmentation of thyroid was diagosed goiter. It reached apple size and was firm and resistant. At autopsy the right lobe was found to contain a cyst of nut size with a fibrocalcareous wall, containing a chocolate colored fluid. Microscopically, it was a simple adenoma, in part colloid, in part made up of small cellular nests of embryonic type. There was no evidence of atypical carcinomatous proliferation.

CASE 73. Woelfler (73). A woman, 57 years of age, had severe headaches followed by the appearance of a tumor of the left frontal bone. In one year it had reached goose egg size. Extirpation was followed by healing. The patient died during the same year. Microscopically, the tissue was typical goiter, "interacinar adenoma of thyroid gland," with no evidence of malignancy. (The accompanying drawings show many solid cell nests.)

In the left half of the thyroid a hard tumor which reached fist size appeared before the thyroid tumor. There was occasional pain on swallowing. (The menses stopped simultaneously with the appearance of the thyroid tumor, followed by periods of hæmaturia at intervals of 6 weeks.) *No microscopic examination. No autopsy.*

CASE 74. Zadek (74). A man, 56 years of age, experienced pain and lameness following a fall. The X-ray showed a rarefied area at the base of the femoral neck. Sixteen months later a pathological fracture occurred. A large cavity filled with reddish tissue was curetted out. Microscopically, it was "thyroid adenoma. . . . Aberrant thyroid." Seventeen months later hæmorrhage from the site of the fracture was followed by death.

Physical examination showed the thyroid to be normal. *No microscopic examination* and *no autopsy* was made.

CASE 75. Zahn (75). A woman, 53 years of age, had had left-sided facial palsy and deafness 13 months previously. Eleven months later, weakness, coldness, and formication of the lower extremities were followed by paralysis. There was anæsthesia below the umbilicus. The Babinski-reflex was present, together with urinary incontinence, emaciation, and a sacral decubitus. There was a pulsating tumor at the level of the ninth rib to the right of the vertebral column. *Autopsy.* A nodular nut-sized tumor of the temporal and occipital bones involved the middle ear, the facial, acoustic, and hypoglossal nerves with pressure on the cerebellum. There were constriction of the left transverse sinus and direct extension of new growth into the jugular vein. Another tumor of the skull was found near the carotid canal. Kyphosis could be noted at the level of the seventh cervical vertebra. A soft, fluctuating tumor the size of a chicken's egg involved the eighth to the tenth thoracic vertebræ, entered the spinal canal, and compressed the spinal cord. Near the costochondral junction of the third right rib was an irregular tumor. There were similar tumors at the costochondral junctions of the second and third left ribs. Microscopically all tumors showed similar architecture. At the periphery was an acellular connective tissue capsule. Small alveoli were filled with cells or a homogeneous mass and surrounded by round cubical and cylindrical cells. Regressive metamorphosis was not seen.

The thyroid gland was normal in gross appearance. The left lobe was somewhat enlarged. The right lobe contained cherry-sized adenomata. Microscopically, both lobes showed simple hypertrophy with colloid degeneration. The nodules were simple adenomata.

CASES 76 and 77. Zapelloni (76) reports 2 cases of osseous thyroid tumor. There were no signs of goiter or of thyroid cancer. *No autopsy* was performed and *no histological examination* made.

CONCLUSIONS

1. The original observations of supposed metastases of normal thyroid tissue by Cohnheim and by Morris have been widely quoted and have influenced many others to report somewhat similar cases.

2. Cohnheim's case-report of "Simple Colloid Goiter with Metastasis" contains

abundant evidence of primary carcinoma of the thyroid gland.

3. In Morris's case there was no examination of the thyroid gland.

4. In most of the collected cases the diagnosis of "benign metastasizing goiter" was based upon the clinically benign appearance of the goiter and upon the benign microscopic appearance of extirpated metastases.

5. Metastases of thyroid carcinomata are subject to great variability in microscopic appearance and may assume the structure of normal thyroid tissue, benign thyroid adenoma, or simple colloid goiter. Such secondary growths may function as does normal thyroid tissue.

6. In but 29 of the 77 similar cases which have been collected from the literature was there microscopic examination of the thyroid gland, and in many of these were described areas of undoubted carcinoma. Autopsy was done in but 33 per cent of the previously reported cases.

7. The belief of some writers that these distant metastases represent aberrant thyroid tissue has no basis in fact.

8. The metastases in the cases of so-called "benign metastasizing goiters" show the same striking predilection for bone that characterizes secondary growths of thyroid origin which show frank carcinomatous structure. The vertebral bodies and the cranial bones are most frequently involved. Pathological fractures of the humerus and femur are common. The osseous metastases frequently show fluctuations in size during menstruation and pregnancy. Pulsation is likewise a common finding.

9. Most of the thyroid metastases to bone were diagnosed clinically and roentgenographically as primary sarcomata. Metastatic new-growth of thyroid, prostate, breast, adrenal, or renal origin should be considered in cases of skeletal new-growth.

10. In most instances the authors published the case reports shortly after they discovered the innocent microscopic appearance of the metastases, without waiting to learn of the outcome.

11. Two cases from the University of Michigan Hospital showed osseous metastases of microscopically benign thyroid tissue, associated with clinically negative goiters. One of the cases was reported, soon after operation, as an instance of metastasis of normal fetal thyroid tissue. Both patients subsequently showed clinical evidence of undoubted carcinoma of the thyroid gland and died within 18 months and 2 years, respectively.

12. Many cases are recorded in which the microscopical examination of tissue from the metastasis revealed normal thyroid structure, while histological study of tissue from the thyroid gland showed areas of undoubted carcinoma.

13. There is an abundance of evidence to indicate that there is no such entity as the "benign metastasizing goiter," and that the use of this confusing term should be abandoned.

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THE TRANSPLANTATION OF PARATHYROIDS IN PARTIAL THYROIDECTOMY

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THE careful search for parathyroid bodies on the surgical specimens of thyroid lobes removed during our operative thyroid procedures has resulted in the not infrequent discovery of these bodies, particularly in the region of the upper pole of the gland. We have found them on the posterior surface of the gland, on the internal surface close to the point where the upper prolongation of the gland rests against the trachea, and on the external surface where the pole is in contact with the internal jugular vein. Dr. R. B. Cattell, working on the material from our clinic, has demonstrated several parathyroid bodies within the substance of the gland in the upper pole and entirely surrounded by thyroid tissue.

It is, of course, obvious from the section shown in Figure 1 that it would be impossible to remove the lobe in such a case as this without removing the parathyroid also.

Up to within the last year we have been accustomed to look with complacency on the occasional appearance of a parathyroid body on a surgical specimen and to feel that since it was practically impossible not to remove an occasional upper parathyroid body, and that since we have had but 2 cases of tetany in 3,100 thyroid operations, there was no occasion to be disturbed by their appearance now and then upon a surgical specimen. We felt that our plan of subtotal thyroidectomy was such as to insure the preservation of one or both of the inferior parathyroids and with the incidence of complete tetany as low as stated above, have paid little attention to these specimens of parathyroid except to study their histological structure.

We have within the last 2 years come to believe that the occasional discovery of parathyroids on the specimen should not be made in the laboratory but at the operation by carefully examining the thyroid lobes as soon as they are removed, and that if parathyroid bodies are discovered they should immediately be transplanted with the possibility of their continuing to live, function, and supply their valuable secretion so necessary to the organism should there be a deficiency of that substance.

Dr. R. L. Mason of this clinic has shown conclusively that while gross tetany appears but rarely following subtotal thyroidectomy, many of the signs of partial tetany may be elicited following this operative procedure, such as the accoucheur's hand, following the application of blood pressure cuff, Chvostek's sign, and lowering of the blood calcium. The demonstration of these facts indicates to us the narrow margin of safety which probably exists postoperatively between a sufficient and an insufficient amount of secreting parathyroid tissue available for the organism.

Since parathyroids have been successfully transplanted in animals, since the glands are entirely wasted otherwise, and since every thyroid operator is or should be familiar with the appearance and location of the parathyroid bodies, we urge the immediate search for parathyroids at the operating table and their immediate transplantation when they are found.

We have in the last 6 months found and transplanted parathyroids in 10 cases. We have had no opportunity to demonstrate whether or not they have been successfully grafted, but have kept careful records as to the cases and the location of the grafts in case the opportunity should arise later to demonstrate their persistence or non-persistence in their transplanted state.

The transplantation is always made into the belly of the left sternomastoid muscle, so that there shall never be any question regarding the muscle into which the lobes were transplanted if an opportunity presents itself for examining them at a later time.

The technique of transplantation is extremely simple and requires little further elucidation than is evident in the illustrations.

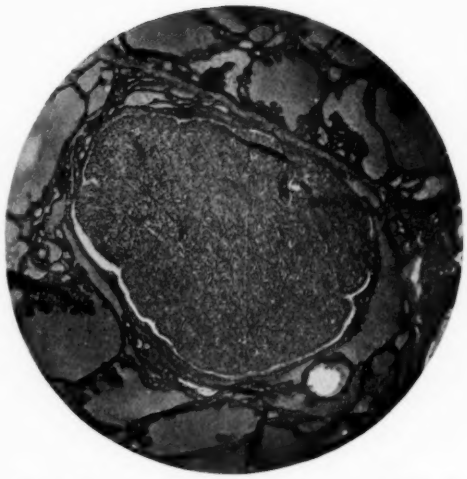

Fig. 1. Microscopic section of a parathyroid gland imbedded in a hyperplastic thyroid which has been converted to involution by iodine.

The lobes should be carefully sponged without roughness, immediately after they are removed. The parathyroids may be distinguished by their characteristic brownish color in moderate contrast to the reddish color of thyroid tissue, by the fact that by gently moving them from side to side they may be demonstrated as attached to but not a part of the thyroid, and by their fairly typical bean shape, with a thickness of only half their length or width.

When they are demonstrated they are gently cut from the gland, care being taken to see that little or no thyroid tissue is taken with the parathyroids and that the bodies are not picked up by instruments. They should be so cut away from the gland with scissors that the gland rests upon the blades of the scissors until it is ready for transplantation.

After we have made sure that there is no attached thyroid tissue, a hole is made in the belly of the left sternomastoid by inserting the points of a pair of blunt scissors deeply into the muscle and gently spreading them apart. If the cavity thus made is dry, the parathyroid is placed within it and the opening closed with two or three stitches of plain

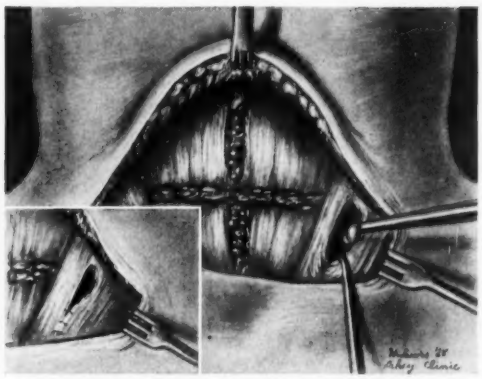

Fig. 2. Showing method of transplanting parathyroid into sternomastoid muscle. Insert showing closure of muscle over transplanted gland.

No. 0 catgut. It is essential that the cavity be dry, as shown by Marine, and should a small vessel be ruptured on spreading the scissors apart, they should be inserted at another location and a dry cavity obtained.

CONCLUSIONS

Since parathyroids will occasionally be removed at operation and identified in the laboratory, they should be carefully searched for on the specimen following operation, and, if found, transplanted.

The belly of the sternomastoid is the most convenient place into which to transplant them, and care should be taken to see that the cavity into which they are transplanted is dry.

Since this article was sent for publication twenty-six additional possible parathyroids have been transplanted and a plan of taking a small section from each transplant has been instituted. This is sent to the laboratory for report as to whether or not the transplant actually is or is not a parathyroid. It is of interest to note that out of twenty-five bodies transplanted as possible parathyroids four have actually been proven by histological examination to have been parathyroids, two were reported possible parathyroids and nineteen were not parathyroids but probably lymph glands.

This note is appended to demonstrate the difficulty of recognizing parathyroids macroscopically and the need of microscopic report to determine in which cases parathyroids have actually been transplanted.

PYLEPHLEBITIS AND LIVER ABSCESS FOLLOWING APPENDICITIS

By E. L. ELIASON, A.B., M.D., F.A.C.S., Sc.D., Philadelphia

PYLEPHLEBITIS and abscess of the liver have come to be regarded by many writers as synonymous. Liver abscess may arise through four channels, the portal veins, the hepatic artery, the bile ducts, and possibly, although in no case has this been demonstrated, through the lymphatics. When the hepatic artery is the portal of entry the abscesses are small and multiple, the patient dying from the original blood stream infection; when the bile ducts carry the infection, the abscesses are distributed accordingly and pus is found in the ducts. The lymphatics as carriers are probably concerned in diffuse peritonitis cases. It is only when the infection travels via the portal veins that we can have both pylephlebitis and hepatic abscesses; even then the two conditions are not always associated as is subsequently shown by one of the cases reported in this paper.

By far the most important single cause of this condition is suppurative appendicitis. Langdon Brown collected 46 cases and found that appendicitis was responsible in 42 per cent. It is, however, true that in some countries dysentery is the most frequent cause of liver abscesses but not of pylephlebitis. Infection in the portal system due to appendicitis may be limited to the vessels of the mesoappendix, the cæcal branches of the colica dextra, or, it may be more extensive and result in a widespread thrombophlebitis of the suppurative type with a single or more often multiple hepatic abscesses. If the abscesses are single, infection usually involves the right side of the right lobe and probably is due directly to a septic embolus from one of the appendiceal vessels (Cases 2, 4, 7, 13).

Sérège (Bruggeman) seems to have proven by means of Chinese ink injections that there are two currents of blood in each portal vein; one originating from the superior mesenteric vein, going to the right lobe; the other coming from the inferior mesenteric veins, being distributed chiefly to the left lobe. This may account for the greater frequency of right lobe solitary abscesses, although cases are reported showing left lobe involvement. In the series reported in the present article, however, left lobe involvement was associated only with multiple abscesses. Liver abscesses following a pylephlebitis are usually multiple and are distributed in the immediate vicinity of the portal system. When there is a suppurative inflammation about the appendix, a local purulent thrombophlebitis may occur followed by a loosening of the infected clot with the formation of multiple infective emboli in the smaller hepatic branches of the portal vein. Each embolus of this nature may, and usually does, become the center of a small abscess, and such abscesses may be so abundant as to be strung along the course of a group of vessel branches, much like a bunch of grapes (Fig. 1). Surrounding the abscesses there is intense congestion, as a result of the toxæmia and circulatory disturbances, a parenchymatous change occurs in the entire liver, varying anywhere from ordinary cloudy swelling, central necrosis, and fatty degeneration to a picture very closely simulating acute yellow atrophy (Case 5).

Koerte is quoted as believing that the suppurative process usually travels upward through the retrocæcal tissues. This was not the case in any of the cases reported in this article. It is true that often (10 of the 14 cases) there is evidence of a parietal and retroperitoneal cellulitis shown by œdema, but in none of the reported cases was any pus collection found in these areas. Subdiaphragmatic abscesses occur after suppurative appendicitis but they are probably secondary to a liver abscess that has broken through into this area. This was found to be the case in 2 of the cases here reported (Cases 4 and 13). Occasionally a chronic appendicitis may be responsible for a liver abscess as is illustrated in all probability, although not proven by Case 1 of this paper. In this connection Heyd states that "bacteria carried to the liver do not always undergo proliferation but are

destroyed in the liver tissue resulting in a chromatolysis and vacuolization of the liver cells with the formation of free pigment. Coincidentally there is an invasion of round cells with the ultimate result of a small area of necrosis, later replaced by fibrous tissue." This probably explains the recovery in such cases as Case 12 of this series.

In several places in the literature on this subject pylephlebitis is spoken of as synonymous with pyæmic abscesses of the liver. The writer takes exception to this terminology. It may be true in cases of multiple abscesses but not true in single abscesses. In other words, we may have a localized pylephlebitis or a diffuse pylephlebitis without a liver abscess (Case 4) or we may have either with a single or with multiple abscesses, or there may be no demonstrable pylephlebitis yet a liver abscess may be present (Case 7). The mesenteric veins as well as the omental veins must be considered as carriers of infection into the liver. The omentum is peculiar in its vascularity, containing many converging veins of great length with their walls easily wounded. Eiselsberg demonstrated how rapidly these veins are thrombosed after operation, and Wilkie also showed the ease with which injury and thrombosis of the portal vein occurred. By mere ligation of the omental veins he produced punctiform hæmorrhage in the stomach in 30 per cent of the cases and hæmorrhagic infarcts in the liver in 50 per cent. If aseptic thrombi in omental veins showed these pre-eminent tendencies toward upper abdominal embolism, how much greater must be this embolic tendency in a septic thrombosis as occurs in acute appendicitis cases. These facts may explain two things: first, why liver abscesses sometimes occur without mesenteric phlebitis, and second, why the draining of the omental veins into the gastric vein which in turn drains mostly into the left lobe accounts for left lobe involvement.

Fig. 1. Case 1. Section of liver tissue removed at autopsy showing small abscesses grouped around small portal radicles.

INCIDENCE

Schlesinger states that Stillman in a study of 1,748 cases of appendicitis found that complications occurred in 7 per cent; and of these only 2 (0.14 per cent) were cases of liver abscess. Rendle Short, according to Barlow, found that suppurative phlebitis occurred in 0.4 per cent in a series of 2,714 cases. Gerster reported in a series of 1,189 cases of appendicitis, an incidence of 9 cases of pylephlebitis. Krogins, quoted by Babler, had only 2 in 1,000 cases of appendicitis. He also states that Bell had 8 cases in a series of 1,726 appendicitis cases. Schlesinger in 1924 collected records of all such cases and found but 23 reported, of which 20 patients were known to have recovered by operative treatment. A careful examination of the literature discloses at least 30 more cases with a reported recovery of only 7. This makes the series total 53 cases with 27 deaths (59 per cent mortality). It seems rather difficult to explain 20 recoveries in the 23 cases collected by Gerster as compared with only 7 recoveries in the 30 cases collected in this paper. The total number of cases that have been found reported to date is 53 (see bibliography). It is true that the diagnosis in some of these cases was not confirmed by operation or autopsy. Furthermore in a few instances the diagnosis was that of pylephlebitis with the assumption

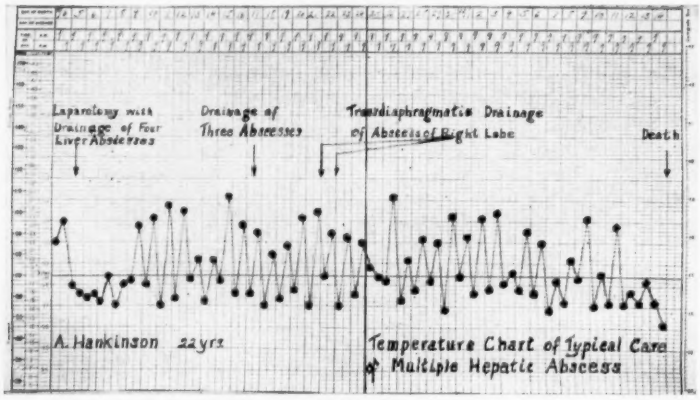
Laparotomy with Drainage of Four Liver Abscesses
Drainage of Three Abscesses
Transdiaphragmatic Drainage of Abscess of Right Lobe
Death
A. Hankinson 22yrs
Temperature Chart of Typical Case of Multiple Hepatic Abscess

Fig. 2. Case 1. Chart showing typical temperature curve of patient with multiple hepatic abscesses.

that hepatic abscess was a co-existing condition. As has been stated above, this is not always true. In the last 2,237 cases of acute appendicitis operated upon at the University of Pennsylvania Hospital, there have occurred only 3 cases of hepatic abscess, an incidence of 0.13 per cent, a percentage closely approximating the figures quoted earlier in this paper. The writer has collected from the University of Pennsylvania, Howard, and Philadelphia General Hospitals, 14 cases in all, 12 of liver abscesses and 2 of pylephlebitis, 10 of which were personal cases. The condition had been present from weeks to months when 7 of these 10 cases were admitted to the hospital. In only 3 of the cases had the original operation for the appendicitis been performed by the writer. All of the personal cases were seen after June, 1922.

SIGNS AND SYMPTOMS

Munro states that the most important clue in making a diagnosis is the recognition of the causative appendicitis. This may be true in the diagnosis of more or less obscure cases of suspicious liver infections but is of no significance when one has a patient convalescing from acute appendicitis who is not doing "just right."

Temperature. According to Gerster "chills accompanied by a rapid rise of temperature, observed during the course of an appendicitis, however mild as to the local symptoms may, and usually do, signify entrance of the septic material into the portal and general circulation." This must be looked upon as a sign of the greatest import, whether it occurs before or after the operation. Occurring before operation it should guard us against too favorable a prognosis. A chill occurring immediately after operation indicates that there has been a rapid spread of the infection into the portal system and in such cases the result is usually profuse pylephlebitis and multiple abscesses of the liver (Case 12). However, should the case show the usual postoperative temperature curves with a gradual drop to 99 or 100 degrees in 3 or 4 days and then a rise to 101 to 102 degrees 5 to 8 days later associated with a chilly sensation, one should suspect a very circumscribed venous infection or thrombosis that has resulted in the floating of a septic embolus into the liver. In this type of case there is frequently only a single abscess, and when this is evacuated recovery results. If the condition becomes one of continuous fever with repeated chills and a temperature of 104 and 105 degrees, a diffuse pylephlebitis and multiple liver abscesses should be suspected. Profuse sweating quickly follows these daily chills. Should the chill and fever persist after the evacuation of a solitary abscess, one must suspect other abscesses.

Leucocytosis. In all of the writer's 10 cases there was a very high leucocyte count with a

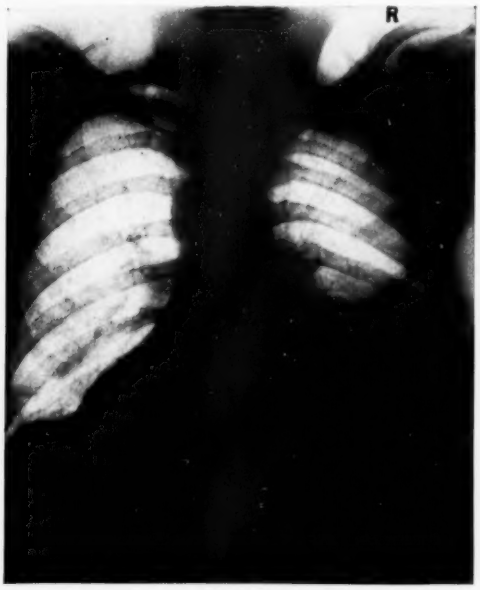

Fig. 3. Case 4. Before drainage of abscess. Right diaphragm high and fixed. Left diaphragm restricted in movement. Shadows at each base.

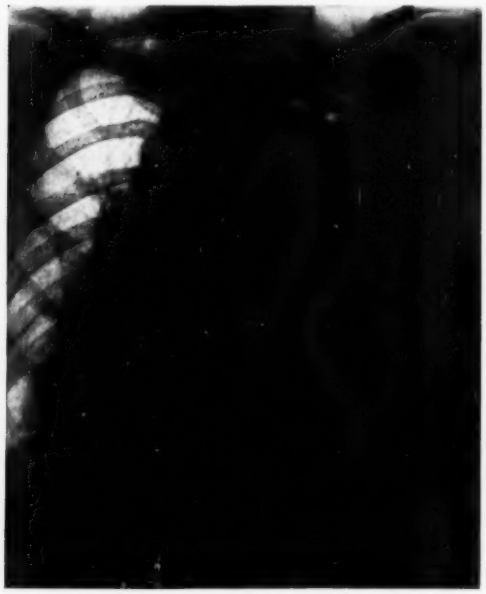

Fig. 4. Case 4. Showing hydropneumothorax, right side after rib resection and drainage of liver abscess of right lobe.

polymorphonuclear increase. In the preoperative counts the highest was 29,000 and the lowest was 10,200. An interesting finding was observed in the course of Case 7. Widal's hæmoclastic test was positive for liver tissue destruction. The leucocytes dropped from 19,600 to 10,600. These high counts persist until relief is given by drainage of the liver focus.

Pain is not a constant symptom, as it is absent or at least not mentioned in many of the case reports reviewed in the literature of the last 10 years. However, when it is present it is located in the right upper quadrant, is dull, and at times pleuritic, at other times it is a dull ache under the shoulder blade. The presence or absence of pain cannot be regarded as of paramount importance in the diagnosis. It was complained of by 5 patients in this series. Multiple abscesses were present in all 5 cases, and in 3 a pathological condition in the chest was evidenced by friction, effusion, and an X-ray shadow in the lower right chest.

Icterus. Jaundice is almost invariably present and appears early in the course of the infection. In fact, its appearance in the patient early in the attack of appendicitis will often lead to the erroneous diagnosis of a gall-bladder disease, the acute appendicitis being entirely overlooked (Case 5). At times a slight icteroid tinge to the scleræ may even precede the postoperative appearance of the warning chill. On the other hand jaundice may be so slight as to escape the examiner's notice entirely, even though the urobilin appears in the urine.

Tenderness. This finding is always present and can be elicited if the hunt is sufficiently careful. It is found over the right lobe of the liver as a rule and can be produced by the fist percussion of Murphy. If the abscess is single and situated as it frequently is on the under surface near the anterior border of the liver, the tenderness can be found by simple palpation. Finger percussion above the tenth rib in the midaxillary line produced pain and tenderness in 11 of the 12 abscess cases, there being no liver tenderness in the 2 cases of pylephlebitis without demonstrable abscesses.

Œdema. In 11 of the cases a localized, firm or boggy œdema was noticed over the region

Fig. 5. Case 4. Six weeks after drainage of subdiaphragmatic and liver abscess. Right diaphragm high, flat, and fixed. Considerable fibrosis at right base.

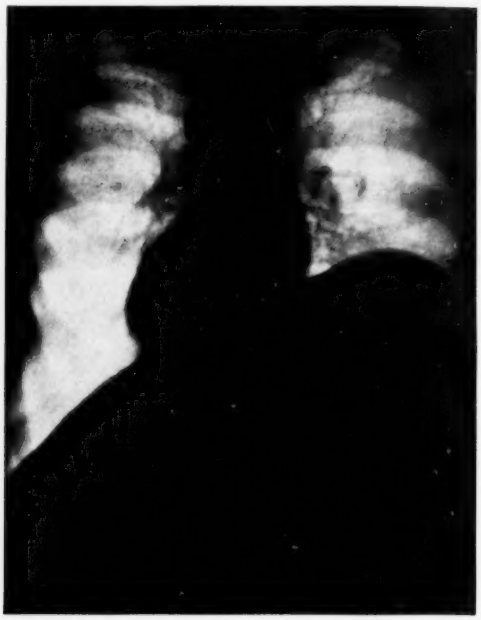

Fig. 6. Case 6. Roentgenogram showing condition two and one-half months after an attack of appendicitis. High right diaphragm with fixation.

of the lower ribs in the midaxillary line, with the characteristics of a lymph rather than a vascular œdema. Compared with vascular œdema, it pitted with more difficulty and the depression lasted longer. Again when the tissues in both flanks were picked up between the fingers and thumbs of each hand, those of its affected (usually the right) side were found thicker than normal. *This sign I have come to consider of enough significance to warrant exploration when the symptoms previously mentioned are present.* In late cases this peculiar doughy condition affects the anterior abdominal wall and is frequently accompanied by an increased prominence of the veins over the lower chest and upper abdomen. This dilated condition was noted in 9 cases.

Nausea and vomiting. In 5 of the series vomiting occurred but it was not a very prominent feature and in most cases occurred only occasionally and then only after taking food. Nausea, however, was bitterly complained of by some. Neither nausea nor vomiting was dependent upon the number or position of the abscess nor could they be used as an index for prognosis.

Ascites. In only 1 case, and that of a severe pylephlebitis, with multiple liver abscesses, was a note found of any undue fluid in the abdomen.

Lassitude, anorexia, emaciation. Without exception the entire series showed these three conditions in a marked degree. Almost invariably the patients would state that they felt all right but were "too tired to sleep." Food was distinctly distasteful and could be administered only under protest. Rapid loss of weight was a marked feature also, varying in its degree with the amount of liver disease.

X-ray findings. Roentgenograms and fluoroscopic examinations were made in 10 cases. Negative reports were returned in only 2. The other 8 cases were all reported by Dr. Pancoast as showing elevation of the right side of the diaphragm, and in some instances restriction of movement on that same side. In 3 of the series there was also a shadow in the lower right chest, interpreted as fluid. This

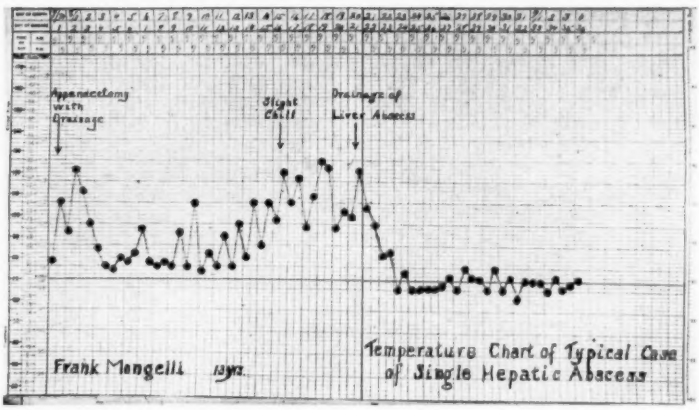
Appendectomy with Drainage
Slight Chill
Drainage of Liver Abscess
Frank Mangelli 13yrs.
Temperature Chart of Typical Case of Single Hepatic Abscess

Fig. 7. Case 7. Chart showing typical temperature curve of patient with single hepatic abscess.

shadow appeared only in those cases in which the abscess or abscesses affected the upper surface of the liver.

These X-ray findings are extremely interesting as they seem to point to the fact that pus in the liver will give much the same phenomena as will subdiaphragmatic pus. In Cases 1, 4, and 13 there was an abscess between the diaphragm and the liver but it was a result of a rupture of a liver abscess into this space as shown at operation, the condition being then one of the hourglass type of abscess.

It may be stated here that in practically all of these cases the clinical diagnosis at first was a basal pneumonia or a subdiaphragmatic abscess. Before operation, however, in each instance the proper diagnosis of liver abscess was made.

Urinalysis. Urobilin was found in the urine in 5 of the cases. It is not mentioned in the other records.

Organisms. Cultures were made in 8 cases of the series. In 4 cases, the organism was streptococcus, in 3 staphylococcus, and in 1 bacillus mucosus; in 1 the culture was sterile. In only 1 was a colon bacillus found. Blood cultures were sterile in the entire group.

NUMBER OF ABSCESSES

In 7 of the 12 cases (58 per cent) only a single abscess was found. These figures are very interesting in view of the fact that they agree with the facts as obtained from foreign literature, but are not in accord with the statements of many American surgeons some of whom state that the fact that the abscess is single and the patient recovers, proves it not a liver abscess but a subdiaphragmatic collection. Solitary abscesses were all in the right lobe, most often in the lateral aspect of the dome. One only was on the under surface.

AGE OF PATIENTS

The oldest patient was 67 years of age; the youngest one with abscess was 13 years old, while the youngest one with pylephlebitis was but 7 years of age. As would be expected the occurrence is more frequent in the period of appendicitis prevalence, namely, in young adult life. Only 2 patients were beyond 45 years of age.

MORTALITY

Seven of the 14 patients lived (50 per cent). This is not as high a recovery rate as that quoted earlier in this article from the cases collected by Schlesinger, namely, 20 recoveries in 23 cases. However, it more nearly approximates the mortality rate (59 per cent) of the entire number of cases, 53, collected by the writer from the literature at the time of writing. Adding the present series of 14 cases with 7 deaths, we have an average mortality of 54.5 per cent. This gives one pause, as many

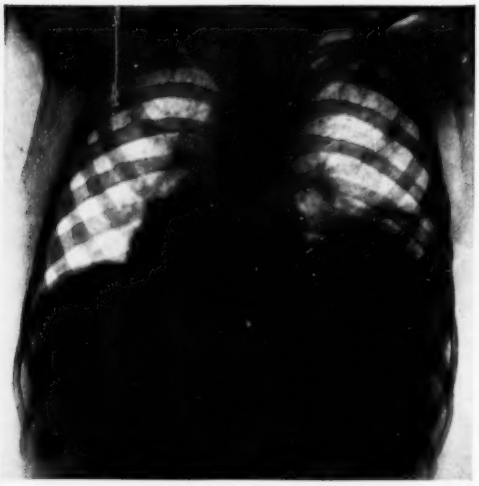

Fig. 8. Case 7. Roentgenogram of chest 18 days after appendectomy. Shadow at right base with high restricted right diaphragm. Slight pleural collection, right lateral chest wall.

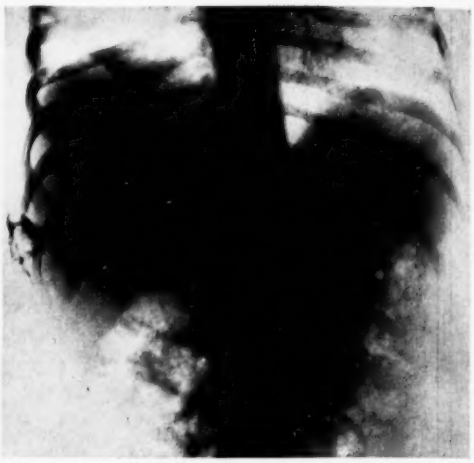

Fig. 9. Case 7. Roentgenogram showing liver abscess cavity outlined with bismuth subcarbonate. This picture was made one week after the abscess had been drained.

textbooks state that pylephlebitis is practically invariably fatal.

If a careful survey of the reported series be made, two very startling facts are brought to light. The first of these is that in every case a provisional diagnosis and often a retained diagnosis of a right basal pneumonia was made. This was based on the physical findings of a compressed lower lobe together with effusion in some instances. The X-ray disproved the pneumonia diagnosis in each case. Therefore in looking over the cases as collected and noting the increasing frequency of diagnosis, 14 cases in 3 years in the writer's service as compared to a previous total of 53 in the literature, one cannot help but believe that in many of these cases a diagnosis of septic pneumonia was made. The X-ray has made this error in diagnosis impossible and has shown the condition as it really exists.

The second startling fact brought out is that a positive operative diagnosis was made very tardily in all cases. In the 3 cases that developed after appendectomy by the writer, the diagnosis was made of pylephlebitis and liver abscess in 14, 19, and 20 days. In the cases coming to the hospital with the condition already present, the histories proved the disease to have been present for periods varying from 2 weeks to 11 months, 3 cases being respectively of 8, 10, and 11 months' duration, a sad commentary on our diagnostic ability.

TREATMENT

Operation was performed in all cases. The 7 solitary abscesses were approached through the chest. Under local anæsthesia the abscess was found with the needle. The rib, usually the tenth, in the midaxillary line was resected, the needle still in place. The diaphragm was sutured in some instances and in others packing was placed against the pleura. The needle was withdrawn and the patient sent back to bed to be returned the following day. An exploring needle was again inserted and when pus was located the actual cautery was slid along the needle until an opening was burned into the abscess cavity. This was then drained with a tube.

In the remaining 7 cases, laparotomy was performed. In Case 1, 7 or 8 operations were performed and as many abscesses drained, including an enormous subdiaphragmatic collection.

CASE 1. A. H., a male, 22 years of age, gave a history of an attack of appendicitis 10 months before

his admission to the hospital. A month later he began to have chills, fever, and epigastric pain. On several occasions he had sharp attacks of pain with vomiting followed by great weakness. On admission he was very much emaciated. His chest showed a few moist râles at the base of the lungs. There was a firm bulging mass in the epigastrium which was somewhat tender and seemed to be located in the liver. He had no jaundice and his urine did not show urobilin. The X-ray examination showed high left diaphragm. The temperature was 101–97 degrees F., pulse, 122; respiration, 28; white blood cells, 13,000. Blood culture showed no growth. (See temperature chart, Fig. 2.) A diagnosis of liver abscess of the left lobe was made. Two days later the abdomen was opened through a right rectus incision and the liver was found adherent to the parietal peritoneum. Its surface was studded with small abscesses, four of which were opened with the cautery and a rubber tube drain inserted. The septic fever continued with little change in the general condition in spite of a blood transfusion and other measures. Two weeks later needles thrust through the previous wound into the liver located 3 small abscesses which were incised by cautery. After 4 days, because of left-sided pain and an X-ray showing a high left diaphragm, an attempt was made to locate pus by the insertion of an exploring needle in the tenth interspace at the posterior axillary line on the left side. The pus was found and a portion of the tenth rib removed preparatory to a transdiaphragmatic drainage. The pleura was found normally thin and transparent, however, so the costophrenic angle was obliterated by sewing the lateral and diaphragmatic pleura together in an elliptical row of sutures, through which the diaphragm was opened and the abscess drained 3 days later. About 4 ounces of yellow pus were evacuated. After the operation the patient remained more comfortable. The pain was less intense and a slight irritating cough disappeared. The temperature curve continued to be of the septic type, however. A week after the last operation, purpuric spots developed over the chest and the patient died 5 days later with asthmatic symptoms. At autopsy the liver was found dotted with small abscesses particularly over the left lobe, and the cut surface showed branched abscesses extending along the portal vein (Fig. 1).

Case 2. J. B., a male, 45 years of age, was admitted to the University Hospital with a history of an acute appendicitis of 10 hours' duration. At operation a gangrenous appendix was removed and drainage instituted. It was noted that the cæcum and the meso-appendix were markedly red and œdematous. Eleven days after a rather slow but apparently normal postoperative convalescence, the patient had a chill with an elevation of temperature. This was the first of a series of chills. The temperature curve was of the septic type, the leucocytes went from 12,000 to 17,000, and slight jaundice of the sclera and face developed. Anorexia, nausea, and vomiting became prominent symptoms so that proctoclysis had to be given. Two blood cultures showed no growth. A fluoroscopic examination of the chest was negative. The abdominal wall, especially the right upper quadrant, gave a doughy sensation to the examining fingers. Small veins were visible in the same area. The liver edge was palpable, soft and not tender. Based on these findings a diagnosis was made of pylephlebitis with liver abscess, 20 days after appendectomy. A medical consultant suggested the possibility of an acute endocarditis, but the negative blood culture, lack of cardiac signs, petechia, blood in urine, and other embolic phenomena made the diagnosis seem probably incorrect. A week later the abdomen was opened through a right rectus incision. From the right iliac fossa extending upward toward the pylorus and thence along the gastrohepatic omentum was found considerable induration and œdema. The mesentery was thick and somewhat stiff. The liver was enlarged and presented a chestnut-sized nodule on its under surface just to the right of the gall bladder. A needle inserted into this area obtained pus. After the rest of the abdomen had been thoroughly packed off, the abscess was opened with a cautery and drained with a rubber tube and several cigarette drains. The pus culture showed streptococcus mitis (Holman). The patient was in a state of grave toxæmia immediately

Fig. 10. Case 7. Photograph of patient 1 year after drainage of liver abscess, showing scars of appendectomy wound and of liver abscess incision.

after the operation, but he rallied somewhat after a blood transfusion and the following day his record showed a temperature of 99.2 degrees with a pulse of 110. Two days after the operation, a left-sided parotitis developed and a day later the other side became involved. The abdominal signs gradually improved but he died 6 days after the operation of profound toxæmia. Necropsy was refused.

CASE 3. J. F., a male, 7 years of age, was admitted to the Pediatric Service of the University Hospital after 8 weeks of illness at home. His sickness, which began with abdominal pain, vomiting and fever, continued, changing to a hectic type of fever, with anorexia, abdominal pain, and distention. On admission the important findings were emaciation, prominent subcutaneous veins in a distended abdomen and two doughy masses, one in each lower abdominal quadrant. The white blood cells numbered 15,000; temperature was 99.6–97.6 degrees; pulse, 116; respiration, 28. A tentative diagnosis of tuberculous enteritis was made and the patient was treated for some time with this diagnosis in mind. Nine weeks after admission he began to have recurrent attacks of higher fever, and slight jaundice appeared with some vomiting and a leucocytosis of 20,000. The patient was then seen by the writer and a diagnosis was made of pylephlebitis following a perforative appendicitis and peritonitis which had been his first illness. Twelve weeks after admission a laparotomy was done through a right rectus incision. All abdominal organs were matted together with dense adhesions which were separated with difficulty. Back of the cæcum was a cavity lined with granulating tissue, evidently an old abscess cavity. The appendiceal stump was hidden by dense new connective tissue. Drainage was instituted through a stab wound at McBurney's point, after several adhesions had been released. The postoperative course was without incident. The temperature reached the normal line on the fourth day after operation, and it showed little variation until his discharge 13 days later. He is now in perfect health and without symptoms.

CASE 4. J. L., a male, 34 years of age, was operated on for acute appendicitis 2 years before his admission to the University Hospital. Since that time he had had several attacks of sudden severe abdominal pain lasting for several days. On one occasion a large amount of pus was drained out through the site of the previous incision. The last attack began 7 days before and continued until his admission. He had a high remittent fever with several attacks of right-sided pain but no nausea or vomiting. A lower right lobar pneumonia developed for which he was treated in the medical wards for 6 weeks. During this time, there developed signs of fluid in each base, especially the right (Fig. 3). Attempts to drain this fluid were only moderately successful and the symptoms remained. The temperature ranged from 97 degrees F. in the morning to 102.1 in the evening, with frequent chills and sweats. He had some pain in the lower right chest on deep respiration and the skin in this area was thick and tough and contained some dilated veins. He was markedly emaciated. White blood cells were 11,800, and the urine showed urobilin. A thoracentesis revealed pus. Under local anæsthesia a piece of the ninth rib was resected and a needle inserted into the pleural cavity. Clear fluid was obtained. When the needle was directed through the diaphragm, however, thick foul pus followed the plunger. The needle track was enlarged and an abscess cavity found in the right dome of the liver. This was drained and packed. The patient did not seem to recover as rapidly as we had expected and a week after operation the roentgenogram was as shown in Figure 4. One day later a needle inserted in the eighth interspace located a pocket of thick greenish pus, which proved to be a subdiaphragmatic collection, easily reached by the finger through the first wound. He rapidly recovered and was discharged with a dry wound. Figure 5 shows the condition on the day before his discharge, 6 weeks after the abscess was drained.

CASE 5. A. R., a male, 42 years of age, was admitted to the Howard Hospital after 12 days of right abdominal pain, vomiting, fever, jaundice, and diarrhœa. On examination a mass was found in the lower right abdomen which proved to be an appendiceal abscess. The remnants of a gangrenous appendix were removed and drainage instituted. The third day after the operation he had a slight chill with subsequent rise in temperature. Two days later active hæmorrhage began from the depths of the wound which was controlled by packing. The patient continued to have chills with a high remittent fever, the temperature range being 105–98 degrees F. The blood culture was negative. White blood cells were 28,600. The urine showed bile pigments. On examination the liver was found somewhat enlarged and tender, the skin was thick over it and the subcutaneous veins were dilated. There was some demonstrable fluid in the abdomen. The right diaphragm was found high and somewhat restricted in movement. The appetite was poor with frequent nausea and occasional vomiting. He continued to grow weaker gradually in spite of blood transfusions. A roentgenogram taken 5 weeks after the operation showed a high right diaphragm, although there was no restriction in its movement noted under the fluoroscope. A pylephlebitis with secondary liver abscess was diagnosed 3 weeks after the appendectomy, but operation was delayed until the patient could be built up a little preparatory to a second operation. Finally, 6 weeks after the former operation a right transverse incision was made under local anæsthesia about 5 centimeters above the umbilicus, exposing a lemon-sized abscess of the lower part of the right lobe of the liver. The liver was enlarged and tender. The abscess was evacuated and drained. Culture of the pus showed staphylococcus aureus. After operation the patient continued to run a septic temperature, gradually growing weaker until his death 11 days later. A

necropsy showed marked œdema of the mesentery and gastrohepatic omentum, with almost occluding thrombosis of the portal vein. The liver was enlarged and studded with abscesses of varying sizes which extended along the portal radicles. Two of these abscesses had been drained.

CASE 6. N. DeL., male, 40 years of age, had an attack of acute appendicitis, which was treated at home by his family doctor. Two and a half months later he was taken with a "grippy feeling," jaundice, and dull pains in upper abdomen. He had no appetite, no nausea, and no vomiting. He had occasional chills. On admission to the University of Pennsylvania Hospital, he was found markedly emaciated, and moderately jaundiced with rather marked rigidity of the upper recti and right upper quadrant. A tender mass was palpated in the epigastrium. The skin over the right upper abdomen was thick and several dilated veins were visible. The X-ray showed fixation of the right diaphragm and high position (Fig. 6). White blood cells numbered 21,000. Urine contained bilirubin and urobilin. A liver abscess was suggested through diagnosis. At operation the liver was found enlarged and the gall bladder was tense. When the gall bladder was opened viscid bile was obtained, followed by thick pus. A cholecystostomy was performed. The patient grew steadily worse after the operation in spite of the fact that the drainage was profuse and the liver reduced in size. The temperature progressively rose to 102.6 degrees and the pulse to 136, and he died in profound toxæmia 1 week after operation. The necropsy showed a large liver abscess communicating with many smaller ones of the branching biliary type.

CASE 7. F. M., male, 13 years of age, was admitted to the University of Pennsylvania Hospital after 2 days' illness with diffuse peritonitis. An appendectomy was performed immediately and drainage instituted. The patient was wildly delirious with high fever for 2 days after operation, but on the fourth day peristalsis returned and the temperature reached normal. Thirteen days after operation he was allowed out of bed in a chair for 20 minutes. While he was up the temperature rose to 101 degrees F. The fever persisted to the fifteenth postoperative day with daily morning remissions and evening rises with a slight chill or two (Fig. 7). A lobar pneumonia was looked for but no definite chest signs could be discovered. The right diaphragm was fixed, however; there was a slight bulging of the lower intercostal spaces and some tenderness at about the tenth rib in the anterior axillary line. There were dilated veins over the lower lateral chest wall and a boggy tough œdema which pitted slightly on pressure. A diagnosis of pylephlebitis or liver abscess was made. Widal's hæmoclastic crisis showed:

	W. B. C.
8.30 a.m.	19,600—before 180 c.cm. milk
9.00 a.m.	17,400—½ hr. after milk
10.00 a.m.	13,300
10.30 a.m.	10,600

Three days later an indefinite mass could be palpated in the region of the right lobe of the liver. Rigidity of the upper right abdominal wall could be demonstrated. The lower right chest showed no expansion, impairment to percussion, increased fremitus, and no suppressed breath sounds. The roentgenogram of the chest is shown in Figure 8. He was operated on 21 days after the appendectomy. An exploring needle was introduced below the seventh rib in the anterior axillary line, into the pleural cavity. No fluid was obtained. When it was introduced downward pus was found. A piece of the tenth rib was resected and a second needle inserted into the abscess cavity. The drainage tract was enlarged with a hæmostat and later with the finger. The cavity occupied the upper part of the right lobe of the liver and was the size of a lemon. The pocket was packed with plain gauze. The temperature reached the normal line 2 days after operation and he rapidly gained strength. A week after the drainage of the abscess, the cavity was filled with a 10 per cent suspension of bismuth subcarbonate in sterile paraffine oil and a roentgenogram was made (Fig. 8). He was discharged before the sinus had closed which occurred about 4 weeks after the operation. He is now in excellent health (Fig. 9).

CASE 8. C. McG., male, 20 years of age, had severe lower right abdominal pain 10 days before admission to the hospital. The abdomen was tender and rigid. Gradually the pain grew less, but shifted to the right upper abdomen. He had several slight chills and on admission his temperature was 102 degrees F.; pulse, 100; respiration, 34. There was no jaundice, and no tenderness over the liver: the leucocyte count was 26,300. A diagnosis of liver abscess was made. An exploratory laparotomy by another surgeon was performed through a right rectus incision. The liver was found enlarged but without any nodulation on its surface. No other pathological findings were reported and the wound was closed. The patient did fairly well for 2 days after operation. On the third day jaundice was noted, the white blood cells were 30,800, and he began to cough. The abdomen was markedly distended, the temperature averaged 102.5 degrees F., and he had several chills. A blood culture showed no growth. On the sixth day, the wound separated when it was dressed, and a second operation was necessary to close the wound. Intravenous saline solution was given. Three days later he became delirious, the temperature continued of a high, hectic type, with occasional chills and sweats. He showed marked emaciation and would not eat. Signs of pulmonary consolidation developed, then of fluid at the right base. Death occurred 17 days after operation. At necropsy a gangrenous appendix was found. Induration of the mesentery extended upward toward the liver. The liver was enlarged, adherent, and showed many abscesses, larger centrally than peripherally, extending along the portal vein. Bloody fluid was found in each pleural cavity with consolidation and abscess formation of the left lung.

CASE 9. M. B., a male, 34 years of age, was operated on for acute appendicitis 8 months before his admission to the hospital. After he had been at home for a short time he noticed some soreness in the right side of the abdomen, with an occasional sharp pain, especially on sneezing or coughing. On several occasions he became deeply jaundiced, and continually suffered from nausea, vomiting, poor appetite, and loss of weight. Examination showed the patient to be emaciated and somewhat jaundiced. The liver was enlarged and tender. The right upper abdomen was somewhat rigid. The temperature was 100.5 degrees F.; the pulse, 104; respiration, 24; urine negative; white blood cells, 10,200. At operation (Dr. C. H. Frazier) the abdomen was opened through a right rectus incision. The liver presented a rounded mass in the right lobe, about 5 centimeters from the lower border. An aspirating needle inserted in this area obtained pus. An inch of an overlying rib was resected and about 20 ounces of pus aspirated. The abscess cavity was packed with gauze and one rubber tube drain was inserted. Three pieces of gauze were packed between the liver and the abdominal cavity, and the abdominal wound closed with drainage. The patient's postoperative course was uneventful. The temperature reached normal 3 days after operation, and he was discharged on the seventh day to be dressed by the family physician.

CASE 10. A. M., a male, 25 years of age, had a history of several attacks of lower right abdominal pain, and finally of an appendectomy 8 months before admission. His condition did not improve and 2 months later he was admitted to the hospital where a subdiaphragmatic abscess was found and drained. He improved somewhat and left the hospital against advice. He returned 5 months later with a draining sinus but again left before he could obtain proper treatment. After a month had passed he returned once more. He had a temperature of 104–97 degrees F. with chills, pain and tenderness in the upper right abdomen and moderate jaundice; white blood cells, 17,200. On the day of his admission he was operated upon (Dr. J. B. Carnett) through a right rectus incision. A large liver abscess was found, projecting upward beneath the right diaphragm. An opening was made above for drainage via the subdiaphragmatic tract previously opened, and one below for drainage through the abdominal incision. The patient improved somewhat for a time, but about 3 months later he began to show a high temperature, and developed pain in the region of the liver. The abscess cavity was opened and drained again but the patient failed to improve and died 3 weeks later. Necropsy was refused.

CASE 11. C. W., a male, 12 years of age, was admitted to the hospital with the chief complaint of chills and fever. Ten months previously he had an attack of lower right abdominal pain with vomiting and fever and was treated as a case of typhoid fever for 12 weeks. (Probably appendicitis.) He was not benefited, however, and began to have chills, fever and upper right abdominal pain. Six months after the onset of his trouble he was operated on. Mucus and a few gall stones were found in the gall bladder which was drained. He continued to show a remitting type of fever and had lost considerable weight. On admission his temperature varied between 95 and 104.5 degrees. His liver was found somewhat enlarged and there was a sense of resistance and some tenderness in the right upper abdomen. He was slightly jaundiced. White blood cells numbered 18,000. Urine showed bile pigments. The fluoroscope showed a high right diaphragm. At operation many adhesions were found and separated. The liver was enlarged and there was a marked œdema of the gastrohepatic omentum, with many enlarged lymph nodes. The common duct was drained and a cholecystectomy performed. The day following operation the patient had a severe chill and 2 days later a distinct jaundice was noted in the skin and sclera. Œdema of the lateral abdominal wall with dilatation of the skin capillaries was noted on the tenth day after operation and the fluoroscope showed the diaphragm to be high and fixed. An aspirating needle was inserted in the ninth interspace in the posterior axillary line and thick foul pus was obtained. The opening was enlarged along the needle and about 8 ounces of pus evacuated. Drainage was inserted and the cavity packed with gauze. When the pus was found the common duct tube was removed. The day following the abscess drainage he became delirious, the jaundice was very deep and he refused food. He died 5 days later. At autopsy a well walled-off solitary abscess cavity was found occupying a greater part of the right lobe of the liver. On the upper portion, the abscess wall had become very thin and was almost ready to rupture into the subphrenic space.

CASE 12. M. I., a male, 31 years of age, after 2½ weeks of abdominal pain, fever and nausea, was seen by Dr. Alfred Stengel, who diagnosed an acute appendicitis with abscess. He was sent to the hospital and operated on at once. The appendix was found acutely inflamed and the abdomen containing seropurulent fluid. An appendectomy and drainage had been done elsewhere. The recovery was normal except for a slight elevation of temperature which was attributed to a stitch abscess. Two weeks after the operation the patient was allowed out of bed for the first time, and while sitting quietly in his chair, was suddenly taken with acute abdominal pain which continued and became localized in the lumbar region on both sides. When admitted to the University of Pennsylvania Hospital his pain had continued for 6 weeks accompanied by fever of the hectic type and profuse sweats. Pain was constant, worse after meals, often associated with a bloating sensation and not well localized, but mostly on the right side of the abdomen. He had vomited several times, had had no chills and had no appetite. He was slightly jaundiced. On examination his chest seemed normal. The abdomen gave an indefinite sense of resistance and marked tenderness especially

over the right side, above and external to the right rectus scar. The liver seemed slightly enlarged. The temperature was 101–99 degrees F.; pulse, 98; respiration, 20; white blood cells, 14,400. The urine showed a trace of albumin and an occasional hyaline cast. Blood culture was negative. The X-ray of the chest was negative. The patient was seen by the writer at this time and a tentative diagnosis was made of postoperative partial obstruction, probably inflammatory. At operation, 13 days after admission, the abdomen was opened through a right rectus incision and the peritoneum was found to contain a large quantity of clear straw-colored fluid. A large mass was found in the epigastrium which was composed of indurated mesentery. The induration was most pronounced in the region extending from the appendix up to the gastrohepatic omentum involving the latter and the retroperitoneal tissues. This whole area was markedly œdematous and the gastrohepatic omentum was more than an inch in thickness. The liver showed no surface indicative of disease but deep palpation disclosed numerous nodulations of various sizes, highly suggestive of a pylephlebitis of the liver veins, substantiated by the induration of the lower portal system. The œdematous condition of the mesentery completely obscured the pancreas. Numerous adhesions of the small intestine were separated and it was noted that the resulting bleeding was excessive, probably due to the obstructed portal circulation. The wound was closed without drainage. The postoperative diagnosis was pylephlebitis, secondary hepatitis, with intestinal adhesions causing partial intestinal obstruction. The postoperative course was uneventful except that the temperature rose occasionally above the normal. The patient was discharged 25 days after the operation. Two weeks after his discharge an abscess ruptured spontaneously through the upper end of the wound, which drained bile-stained pus for several weeks. He is now in good health and without symptoms.

CASE 13. E. G. F., a female, 67 years of age, was taken sick 9 days before admission with lower right abdominal pain. Three days later she was seen by her physician, who made a diagnosis of acute appendicitis and sent her to the hospital. At operation (Dr. F. E. Keene), a retrocæcal mass was found well walled off, secondary to a ruptured retrocæcal appendix. The abscess was drained through a gridiron incision. Five days after operation the temperature was normal and the patient was feeling well. The wound was draining well. On the eighth postoperative day the drainage tube had been removed but the patient began to show an afternoon elevation of temperature to 100.3 degrees F. This continued, increasing to 102.2 degrees on the fourteenth day, in spite of the fact that the operative wound seemed well drained. An internist who saw the patient 4 days later found complete consolidation of the right lower lobe, with tubular breathing, but few râles. A diagnosis of atypical lobar pneumonia was made. The patient continued with little change for a week. An X-ray of the chest made on the twenty-seventh day after operation showed no lobar pneumonia, but a high right diaphragm and a subdiaphragmatic condition was suggested. The following day (4 weeks after operation) the patient was seen by the writer. She was emaciated and pale. Her previous operative wound seemed satisfactory. The right diaphragm was high; little movement could be demonstrated. There was a boggy sensation to the lateral abdominal wall over the hepatic region and several small dilated veins were plainly visible. This area was acutely tender on moderate pressure. There was slight jaundice but no nausea. White blood cells numbered 20,100; temperature was 99.6–97 degrees; pulse, 110; respiration, 46. Urine was negative. A diagnosis of hepatic abscess of the right lobe was made. Five days later under local anæsthesia, 3 centimeters of the tenth rib was resected and an exploring needle inserted through the diaphragm revealed thick yellow pus. An opening was made along the needle with the cautery into a large pocket and about 14 ounces of pus evacuated. Digital examination showed the abscess extending through a finger-sized opening into an abscess cavity in the dome of the liver about the size of a hen's egg. Gauze packing was inserted in the cavity. The pus culture showed bacillus mucosus capsulatus. During the week following the operation the temperature gradually returned to normal and remained there with little variation throughout the stay in the hospital. The abscess cavity ceased to drain on the twenty-fifth day after operation. The patient gradually regained strength, was allowed out of bed on the twenty-seventh day, and was discharged with the wounds nearly healed 6 weeks after the abscess drainage. She is now in good health and without symptoms.

CASE 14. M. K., female, age 29, was operated on for appendicitis and drainage was instituted. Two weeks after operation the temperature began to mount to 101 degrees but there was no chill, and the patient developed symptoms of intestinal obstruction with pain, tenderness, and a mass to the mesial and upper sides of the wound. A few days later this tenderness had extended to the left of the umbilicus. The abdominal wall over the entire right side presented a doughy feel to examination. Peristalsis was diminished except in the upper left quadrant. Pelvic examination revealed an empty ballooned rectum otherwise normal. There was no liver tenderness and the chest examination was negative. White blood cells numbered 18,000. Urine was negative. The diagnosis made was intestinal obstruction due to abscesses among the coils of the ileum. Operation by the writer revealed several abscesses distributed among the coils of the small intestine, one of which was obstructed. The mesentery was indurated and fully ½ to ¾ inch thick on the right side of the abdomen, corresponding to the venous channels draining the appendiceal area. Some of the veins appeared to be thrombosed. The liver could not be examined because of adhesions.

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An enterostomy was done in the distended gut and the abdomen drained. After a stormy convalescence the patient completely recovered and is now back at her occupation of nursing. Diagnosis: pylephlebitis, abdominal abscesses, and intestinal obstruction.

SUMMARY

1. Pylephlebitis and liver abscess are not identical and occur as a complication in from 0.1 to 0.4 per cent of cases of appendicitis.

2. The X-ray and fluoroscope aid in early diagnosis by showing a high diaphragm sometimes with restricted movement.

3. Local œdema and prominent veins are valuable diagnostic signs.

4. Pain is not always present. It is noted most when the infection is in or on the upper surface of the liver.

5. Pneumonic signs are frequently the result of lung compression rather than pneumonia.

6. Jaundice is practically a constant symptom.

7. The presence of lassitude and anorexia is very suggestive in the diagnosis.

8. The prognosis is not universally bad as 54 per cent of the patients recover.

9. Operation through the diaphragm is the treatment of choice.

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ANTERIOR ABDOMINAL HYSTEROTOMY FOR THE INTERRUPTION OF PREGNANCY AND STERILIZATION: ITS INDICATIONS[1]

By PHILIP OGINZ, M.D., Brooklyn, New York

INTERRUPTING pregnancy by anterior abdominal hysterotomy and at the same time sterilizing the patient is a procedure that has not been practiced in this country, even when the condition indicated the advisability of the operation. One must come to this conclusion after a careful search through the literature of the past 40 years. The only reference that I was able to find is a report of a case by Charles Child, Jr., in 1910. It is probable that gynecologists and obstetricians have long practiced some such procedure for combined abortion and sterilization "per abdomen." However, we have not attached sufficient importance to the subject, considering the seriousness of the problem, and the difficulty it often presents in the matter of judgment. Abroad, this type of operation has not been neglected, and various methods, modifications, and improvements have appeared from time to time. I have had occasion to operate in 18 cases of this nature, and have gradually evolved a simple technique, the elements of which in all probability have been utilized by others, but in a somewhat different manner. The use of this method, where there are positive indications for it, has proved an excellent way of handling these difficult cases.

At the meeting of the New York Obstetrical Society, where Dr. Childs reported his case, Dr. Polak mentioned that on three different occasions he had employed a somewhat similar procedure. The method described by Childs consisted in opening the abdomen by a low transverse incision, making the posterior fundal uterine incision reach both cornua, emptying the uterus, and then resecting the isthmic portion of the tubes and burying the free ends in the folds of the broad ligaments, then dilating the cervix, and packing the cavity with iodoform gauze. Such a technique was followed by the Germans for several years, until 1913, when Selheim made the transverse uterine incision immediately below the fundus posteriorly, and then resected either part or the entire tube, thereby doing away with the danger of infecting the uterine cavity through the cut tubal ends. This method was shortly followed by one which utilized a longitudinal incision on the posterior surface and then resected either a part or the entire tube. Subsequently, the longitudinal incision was brought to the anterior surface of the uterus in the cervical region. This necessitated the peeling back of the bladder deflection and involved great risks of infecting the normally sterile uterine cavity, with infection of the cervix which almost always is present.

Dorfler, in a recent article entitled "*Kleiner Kaiser-Schnitt*," advocated peeling back the bladder, making a low cervical incision, emptying the uterus, then resuturing the bladder over the incised area in an attempt to eliminate the raw surface. He sterilized by resecting part of the tube.

There still remain to be mentioned several other ways of combining therapeutic abortion and sterilization in one operation. Some gynecologists have tried the vaginal route, first emptying the uterus, then deflecting the bladder, opening the anterior cul-de-sac, bringing out the uterus, resecting the tubes, and finally, closing the cul-de-sac, bringing down the bladder, and closing the anterior vaginal wall. Thus, they avoid opening the abdomen at the expense of a procedure requiring much more time, a much greater loss of blood, and a far more difficult technique.

Other methods that have been employed by various surgeons are the following:

One is to empty the uterus by curettage and to send the patient home to recuperate with the understanding that she is to return for a sterilization operation later. This is almost uniformly a failure; for the patient rarely comes back until she is pregnant again. In the meantime, her general health is being undermined by a constant dread of a possible pregnancy. Another is the combined method of

[1] Read before the E. N. Y. Medical Society, April 28, 1925.

emptying the uterus from below and then subjecting the patient to X-ray or radium. This is of value in women approaching the menopause, but should not be used in young women because of the sudden, artificial menopause it causes. I will just mention in passing repeated curettage without sterilization. This is merely a palliative measure, and is entirely inadequate. It involves the subjection to repeated anæsthesias and operative interferences which may prove disastrous.

Abdominal hysterotomy with sterilization is performed only on women who are exceedingly poor surgical and anæsthetic risks. The characteristics of what might be called the ideal operation for these cases are the following:

1. The procedure must be sufficiently simple to come within the surgical skill of even the occasional operator. In other words, it should not be more difficult than a simple appendectomy.

2. The blood loss should be reduced to the absolute minimum.

3. Sterilization must be complete.

4. The operation must require very little time for its completion.

5. The anatomical or structural relationships must be disturbed as little as possible, so that

6. The operation can be done under ether, gas, local, or spinal anæsthesia with equal facility.

The technique which I have followed for the past 4 years fulfils all these requirements, and can easily be done by the average gynecologist or surgeon within the half hour under any form of anæsthesia.

A mid-abdominal incision is made from an inch or two below the umbilicus to the symphysis. The uterus is seized by a tenaculum, brought out of the abdomen, and then well walled off by lap sponges. A 4 or 5 centimeter incision is made in the midline beginning at the fundus and extending toward the cervix through all the uterine coats. The membranes usually bulge through the incision and are ruptured. The embryo and placenta are detached and removed with a gauze-wrapped finger or a sponge stick forceps introduced into the cavity of the uterus. Here a little difficulty is encountered because the spongy layer of the decidua is not fully developed and does not separate easily. There is little bleeding from the placental sinuses. The delivery of the membranes and the placenta is followed by an injection of 1 cubic centimeter of pituitrin directly into the uterine musculature. This contracts the uterus fairly well. A continuous suture of No. 2 plain catgut brings the musculature of the uterus together, but does not take in the endometrium. A second seromuscular layer of continuous No. 2 plain gut followed by a peritonealization of the raw surface, closes the uterus firmly, preventing any possible leakage. The tube is now grasped by an artery clamp at its isthmic portion and picked up, so that a knuckle is formed. A fine needle carrying silk is passed under the tube at the apex of the knuckle and tied first over one limb and then over the other. The apex of the knuckle is cut off with the scissors and both raw surfaces are cauterized by thermocautery or carbolic and alcohol. The same is repeated on the other tube. A rapid inspection is then made and the abdomen is closed. The operation is followed by as little postoperative inconvenience as that following an interval appendectomy. In my series of cases very little pain was experienced and the temperature never rose to over 100.5 degrees F. The patients were returned to the care of the medical men on the tenth or twelfth day after the operation. During convalescence, very moderate vaginal bleeding due to the throwing off of small placental rests is a common finding. Not a single one of my cases showed any morbidity.

The operation can be done at any time during the pregnancy.

In the early months a 2-inch abdominal incision, just large enough to admit two fingers, may be adequate for the entire operation.

The anterior uterine incision has the advantage over the posterior one, in that, while the latter may cause adhesions to either the omentum or the intestines, the former may cause adhesions to the bladder or to the anterior abdominal wall, which only serve to suspend the uterus. The above method of treating the tubes is better than any type of resection, inasmuch as it does not interfere

with the anastomosing circulation between the uterine vessels and the ovary. If the tubes are resected the utero-ovarian anastomosing vessels are removed, and the ovary may become cystic.

It is of importance to note that in Europe, special curettes and dilators were devised to clean and dilate the uterus from above. However, I have found it absolutely unnecessary to use either curettes, dilators, or uterine packings.

Because of the ethical and moral principles involved, as well as because of the bad operative risks which the cases present, this operation must never be considered except when certain, definite indications exist, and then, only after an internist and a gynecologist have held a consultation. As a gynecologist, I can only enumerate the conditions in which the operation is indicated and give you the opinions of several internists as expressed to me. This operation is indicated for those women who are suffering from a chronic, debilitating disease with little or no hope of a cure, and in cases in which experience has shown that the continuation of the pregnancy would certainly shorten, or even terminate the patient's life. Specifically, the diseases wherein these conditions are indicated come under four groups: (1) pulmonary tuberculosis, (2) certain cardiac diseases, (3) chronic nephritis and hypertension, and (4) unusual cases.

1. *Pulmonary tuberculosis.* Abortion and sterilization should be effected in cases of pulmonary tuberculosis which run a subacute course characterized by fever, rapid pulse, sweats, and loss of weight, and especially by one or more previous therapeutic abortions for a similar condition. For example:

CHART NO. 1-738. M. H., age 24, born in the United States, was admitted into the King's County Hospital, July 5, 1923. She is pregnant and has tuberculosis. "Doctor said that she should come to the hospital to have an abortion performed."

There was a history of two therapeutic abortions, one in 1921 and the other in 1922, two pulmonary hæmorrhages within 1 year, and positive sputum. The patient had lost 10 pounds, and had had no children.

The diagnosis of a 10 weeks' pregnancy was made. Medical consultation: "Pregnancy too much for her on this occasion. The condition makes it absolutely necessary that she shall not carry this conception. Her health depends upon longer freedom from extra burden. Termination demanded."

An abdominal hysterotomy with sterilization was performed on July 9, 1923, with gas as the anæsthetic. The operation was completed in 25 minutes. On the tenth day, the patient was permitted "out of bed." She was discharged on July 21, 1923, with primary union of abdominal wound, no induration, no tenderness, and the pelvis entirely negative.

This case illustrates the uselessness of abortions without sterilization. The patient already had undergone two operative procedures in both of which anæsthesia had been induced, and on both occasions she had been emphatically instructed that it would be dangerous to become pregnant again. She was told to return at a later date for sterilization. Without a doubt, each pregnancy as well as each abortion aggravated the lung condition. In order to give the lungs a chance to heal, and to eliminate the dread as well as the actuality of another pregnancy, it was necessary to accomplish abortion accompanied by sterilization.

In this connection it is interesting to note that according to M. A. Couvelaire, "38 per cent of children, born of tuberculous mothers, removed from their mothers immediately after birth, and brought up under the best conditions, do not survive their first month."[1]

2. *Cardiac indications for sterilization.* Aortic regurgitation is a positive bar to pregnancy because the strain upon an overburdened left ventricle may be great enough to cause acute dilatation of the left heart with the onset of pulmonary œdema. Especially dangerous are the cases of aortic regurgitation complicated with a relative mitral regurgitation or that have at any time become decompensated. Sterilization is indicated if there is a mitral lesion and the cardiac reserve has become exhausted, as evidenced by repeated attacks of decompensation. This is especially true of mitral stenosis. In cardiac arrhythmias, auricular fibrillation is the most important indication. Myocardial degenerations, due to chronic infections, should be relieved of the strain of possible pregnancies.

An example is the case of I. S., 34 years of age, gravida IV, III-para, admitted to the Brownsville and East New York Hospital on March 16, 1924,

[1]Bull. French Soc. Obst. & Gynec., 1923, xii.

"three months pregnant, suffering from marked symptoms of a breaking cardiac compensation associated with mitral stenosis. With her previous pregnancies, her heart had been bad." In the medical consultant's opinion, "the condition of her heart was such that pregnancy was a distinct menace to her life." Anterior abdominal hysterotomy with sterilization was performed March 20, 1924, under gas-oxygen anæsthesia. On the day after the operation, the temperature rose to its highest point, 100.5 degrees F. After that it remained normal. The patient had a slight infection of the upper angle of the wound. On her discharge on April 6, 1924, the cardiac action showed improvement, more regularity and a better quality to heart sounds. The examination of the pelvis was negative.

3. *Chronic nephritis and hypertension.* In the glomerular type of nephritis, if it is known that the glomeruli are wanting in regenerative power and that the disease is little affected by medication and treatment, and if hypertension is present, there can be no question as to the advisability of interrupting pregnancy with sterilization.

If the kidney is nephrotic, sterilization is indicated only when it is found that each pregnancy causes an acute exacerbation and the development of vascular changes. The chronic hypertension of the nephritis calls for a special indication because of its effect on the cardiac condition. Labor entails a relatively sudden increase of blood pressure, sometimes as great as 50 millimeters. This is illustrated by the following case:

CHART NO. 12195. R. L., age 23, was admitted to the Brownsville and East New York Hospital complaining of headache and vomiting.

The history showed that she had been "married two years. The first pregnancy advanced to 6 months when uræmic symptoms developed and a premature delivery was necessitated. Labor was induced by catheter and packing; now pregnant about 6 months." The medical diagnosis was "acute exacerbation of a chronic nephritis."

The urine examined between the first and second pregnancies had always showed albumin and casts. The blood pressure was always above normal. The physical examination on admission showed that she was suffering from a slight cardiac enlargement, a blood pressure of 214-140; the urine boiled solid and showed granular casts and red blood cells. Ophthalmological examination showed both disks and rest of fundus with moderate amount of œdema. In both the macular and paramacular regions were a number of small dot-like retinal exudates. The retinal blood vessels exhibited no evidence of sclerosis.

In consideration of her behavior during the last pregnancy, the history of hypertension and albuminuria between pregnancies, and the present findings, termination of pregnancy with sterilization was considered advisable.

Anterior abdominal hysterotomy with sterilization was done three days after admission, under local anæsthesia induced with ½ per cent novocain. The postoperative course was uneventful and the patient was transferred to the medical service on the tenth day. The blood pressure was 190 and only a trace of albumin was present in the urine.

4. There remain only the unusual cases which will merely be mentioned since they only occasionally require the treatment under discussion. These are cases of (a) recurrent toxæmia; (b) complicated diabetes; (c) certain nervous and mental diseases such as chorea; (d) blood diseases, such as pernicious anæmia and leukæmia; and (e) severe thyrotoxicosis. These cases do not permit of a generalizing law. Each one must be judged on its own merits.

When it is first presented, this method of abortion with sterilization per abdomen seems to be a very radical procedure. However, experience with it soon demonstrates that in the indicated cases, the patients stand the operation very well and recuperate rapidly. No operator either here or abroad, has reported any mortality attributable directly to the operation itself. This is noteworthy, when we consider the fact that the women they had to deal with were all very sick. The technique which I have followed and described to you fulfils all the requirements in that it is simple, entails very little blood loss, it is certain to sterilize, is time saving, and any kind of anæsthetic can be used. The diagnosis of the conditions I have outlined specifically indicates this operation as definitely as the diagnosis of an ectopic pregnancy indicates salpingectomy.

SUMMARY

The operation of hysterotomy for the interruption of pregnancy and sterilization is of great value in certain cases of pulmonary tuberculosis, cardiac diseases, chronic nephritis and hypertension, and some unusual cases; and could be used to the patient's advantage much more often than has been the practice in this country.

Let me here publicly thank Drs. Gordon, Frucht, Dattlebaum, and Harris who have kindly given me their views as to the pathological conditions that form the basis of the indications for operative procedure.

END-RESULTS IN THE INTERPOSITION OPERATION FOR THE CURE OF PROLAPSUS UTERI AND CYSTOCELE

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THE interposition operation, described by the late Thomas J. Watkins of Chicago, is the foundation on which I have built, but my operation differs from any I have seen described in that the whole anterior surface of the uterus down to the cervix is sewed to the *fascia* of the anterior vaginal wall. Thus you get the uterus *firmly fixed* in anteversion to the fascia and the bladder resting on the posterior aspect of the body of the uterus.

In the April, 1919, number of Surgery, Gynecology and Obstetrics, my associate at the Carney Hospital, Dr. L. E. Phaneuf, and I tabulated 90 cases of the interposition operations and the end-results in 68 of them.

The first was operated on May 31, 1909, and the last May 5, 1918, an average of about 10 a year. Eighty-nine were operated on at the Carney Hospital. The mortality was nil. The oldest patient in this series was 69, the youngest 21. Forty-six were between 50 and 60 years of age, while thirty were between 40 and 50.

Almost all of the cases were from the laboring class and as soon as possible were obliged to return to their homes and household duties—just the class that would put any operation for prolapsus and cystocele to its severest test.

From answers received from 68 patients, it appeared that 54 had been wholly relieved of the "troubles complained of at the time of operations," there had been "no falling down of the parts" and there had been "improvement in their general health." This certainly is gratifying, as I know of no other operation for prolapsus uteri and cystocele, attended with almost no danger and no shock, that gives as good end-results.

It is an operation from which elderly and old women recover quickly.

Since May 5, 1918, when the last case in the above series was operated on, up to July, 1923, I did this modification of the interposition operation on 50 patients—about 10 a year or a little over, as I was away 15 months out of these 5 years. In this series, as in the other, the oldest patient was 69. The youngest was 30. Twenty-one were between 50 and 69 years of age; 18 were between 40 and 50 years of age. It was found necessary to repair or amputate the cervix in 41 cases (55 in the former series) and Crossen's or Bandler's operation for relaxed pelvic outlet and rectocele was done in 45 cases (76 in the former series). The mortality was nil.

All in this series of 50 were operated on at the Carney Hospital. Letters were sent to each of the 50 patients excepting those who came to my office for examination; and the following questions were asked:

1. Did the operations relieve you of the troubles of which you complained?
2. Is there falling down of the parts?
3. To what extent has your general health been improved by the operations?

I received 32 replies out of the 50.

It appeared that 27 out of the 32 had been wholly relieved of the troubles complained of at the time of operations: there had been no falling down of the parts and there had been improvement in the general health. Two got partial relief. There was total failure in 3 cases. By this I mean the cervix again presented at the vulva. These were cases of enterocele which I did not recognize at the time of operation, but had considered very large rectoceles. Twenty-seven complete cures (nearly 90 per cent), out of 32 patients operated on, certainly speaks well for this method of dealing with prolapsus uteri and its accompanying cystocele and rectocele.

In the two series, there were 140 patients operated on, reports of end-results were obtained in 100 cases, and 81 patients reported they were wholly relieved.

The opening into the peritoneal cavity anteriorly must be large enough so that the

uterus may be easily and well drawn through into the vagina so that the bladder will lie smoothly, not in folds, and the base be not elevated on the posterior surface of the fundus uteri. For unless these precautions are taken the patient will be very uncomfortable and will complain of symptoms pointing to an irritable bladder.

In almost all of these cases residual urine containing pus, bladder epithelium and colon bacilli will be found, and cystoscopy will show a chronic trigonitis. This ought to be cured before operation, and it can easily be done in a few days by keeping the patient in bed, by thoroughly emptying the bladder with a catheter twice a day, irrigating the bladder with a 4 per cent solution of boracic acid, and after thoroughly draining the bladder instilling into it 2 ounces of a 1:1000 solution of mercurochrome—220, soluble.

For the following reason the bowels are not moved for 7 days. Even though the greatest care is exercised in giving an enema and in cleaning the anus and parts about after defæcation the perineum becomes a little soiled and the perineal sutures may thus become an easy prey to the micro-organisms present.

The kind of diet for the 7 days is such that there is no accumulation of fæces in the rectum.

THE CLINICAL APPLICATION OF RECENT STUDIES ON JAUNDICE

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WITHIN the last decade there has grown up a voluminous literature on the subject of diseases of the liver, particularly those associated with icterus. Newer knowledge of the physiology of the organ has necessitated a readjustment of many previous conceptions of hepatic diseases, and has stimulated the interest of biochemists, physiologists, surgeons, and internists. In this paper I shall review some of the more important recent work on the subject, and discuss its clinical application.

The term jaundice implies a staining of the body tissues and fluids with bile pigments. Bilirubin and its oxidation product, biliverdin, the principal pigment substances in human bile, were formerly believed to be elaborated by the polygonal hepatic cells. While Morgagni taught that the liver acted only as an excretory organ with regard to bile, it was not until the work of Virchow, in 1847, that attention was called to the possible formation of bile pigment outside the liver. The latter's observations on the formation of a substance resembling bilirubin at the site of old hæmorrhagic extravasations, laid the foundations of modern conceptions of jaundice.

Virchow's classification of jaundice as hepatogenous and anhepatogenous was quite generally accepted until the publication of the work of Minkowski and Naunyn in 1886. They administered the powerful hæmolytic substance arseniureted hydrogen to geese from which the livers had been removed, believing that if bile pigments were formed from broken-down hæmoglobin, bilirubin could be detected in the blood serum after such marked destruction of blood. Since they were unable to demonstrate the presence of bile pigments after this procedure, they concluded that jaundice could be only of hepatogenous origin. Eppinger, in 1908, contributed to this belief by a statement (since retracted) that all jaundice of whatever type was dependent on obstruction to the flow of bile, whether this occurred in the common duct or the finer biliary capillaries.

Recently, conclusive evidence has been brought forward supporting Virchow's original hypothesis of the extrahepatic formation of bilirubin. Whipple and Hooper demonstrated the formation of bile pigment in animals after the hepatic circulation had been greatly diminished by anastomosing the portal vein to

the vena cava to form an Eck fistula. They showed further that bilirubin, which cannot be demonstrated in dog serum by the usual tests, was formed in animals with a cephalic and thoracic circulation only, the liver having been entirely excluded. Mann and his associates (19) at the Mayo Clinic have furnished positive proof by removing the liver from dogs, using a three-stage operative technique, which permits the survival of the animal for a period of from 24 to 36 hours. During this time a definite icterus develops, bilirubin appearing in the blood stream in considerable amounts. More recently they have obtained similar results in animals after complete extirpation of the liver by a single operation; their findings have been confirmed by Rich and Makino.

The source of bilirubin is now generally conceded to be hæmoglobin, set free during the normal destruction of blood within the body, hæmatin being transformed into bilirubin by the loss of the iron-containing portion of the molecule. The remaining fraction, formerly spoken of as hæmatoidin, is chemically identical with bilirubin, as has been shown by Rich and Bumstead. The actual transformation of hæmoglobin to bilirubin has not as yet been satisfactorily accomplished *in vitro*, but it has been repeatedly observed in the living animal. The local formation of bilirubin in hæmorrhagic effusions, as originally demonstrated by Virchow, is a well established fact. It is also known that the intravascular injection of laked blood or solutions of hæmoglobin causes a sharp increase in the bilirubin output of animals with biliary fistulas; in Mann's liverless dogs increased bilirubinæmia follows this procedure. Recently Rous and Drury have suggested that the level of serum bilirubin in dogs with obstructive jaundice bears a direct relationship to the rate of destruction of red blood cells.

It has been suggested by Aschoff and others that this transformation of hæmoglobin to bile pigment is accomplished by means of the reticulo-endothelial system. These cells are widely distributed throughout the body; the endothelial cells of the spleen, bone marrow, and lymph glands, and the Kupffer cells of the liver belonging to this group. They act as phagocytes and are known to take up broken-down red cells, the hæmoglobin within the corpuscles being digested, and the iron-containing portion, hæmosiderin, being deposited in the endothelial cells themselves. It is believed that the iron-free portion, either bilirubin or some substance of similar chemical composition, is returned to the blood stream. This hypothesis at once explains the results of Minkowski and Naunyn, since the livers of geese contain the greater part of their reticulo-endothelial structures. In liverless birds the dissolution of hæmoglobin and the subsequent formation of bilirubin were therefore greatly impaired.

Rich (24), in his recent review of the subject of extrahepatic formation of bilirubin, considers it proved that hæmoglobin is the sole source of bile pigment. He believes that there is no evidence that the polygonal cells of the liver or the cells of any other tissue, except possibly those of the reticulo-endothelial system, ever form bile pigment; the evidence that the latter cells manufacture bilirubin is not sufficiently complete to be regarded as proof, although the great probability of such a process is conceded.

The normal pathway of excretion of bilirubin is by way of the polygonal hepatic cells; in certain types of jaundice it may be excreted by way of the kidney. In general, it may be said to behave as a threshold substance with regard to both organs.

On the basis of this theory of bilirubin metabolism, McNee (15) has evolved a theory of jaundice which correlates very well the clinical facts and experimental data now available. By a schematic representation of the liver lobule, he has demonstrated the possibilities of pathological interference with formation and excretion of normal bile pigment. He regards the polygonal hepatic cells as forming a tubule with a blind end, the free end passing into a bile capillary. Surrounding each tubule lie hepatic vascular capillaries, lined with Kupffer cells of the reticulo-endothelial system and carrying blood from the portal to the hepatic vein. Jaundice may be produced in one of three ways. If the bile passages are occluded, bilirubin which has passed through the vascular channels and

polygonal liver cells, is reabsorbed by the blood stream and lymphatics. This type of jaundice is described as "obstructive." If there is an abnormally large production of bilirubin or its precursors within the body, or if there is an impediment to the passage of this substance through the endothelial lining of the hepatic capillaries, bilirubin will accumulate and enter the general circulation without being passed through the hepatic cells proper. This type of jaundice is referred to as "hæmolytic." Finally, if there is hepatic damage, functional or otherwise, not only may normally formed bilirubin fail of excretion, but also that which has passed through the polygonal cells of the liver may be reabsorbed. This is the type of jaundice described as "toxic" or "infectious." McNee (15), therefore, following Osler and Rolleston, proposes that jaundice be classified into three clinical varieties: obstructive, hæmolytic, and toxic or infectious.

The studies of van den Bergh furnish an interesting corollary to the foregoing hypothesis, and incidentally constitute a most important addition to our knowledge of icterus. By developing the well known Ehrlich diazo reaction and adapting it to the estimation of bilirubin in serum, he has produced the most delicate chemical method yet available for this test, and centered interest in icterus on the amount of pigment in the blood rather than on that noted in the skin and excreta. His method may be briefly stated as follows: on the addition of Ehrlich's diazo reagent to serum, in the presence of obstructive jaundice, a purple color appears immediately. This is called the "direct reaction." In certain instances, particularly in toxic jaundice, the color appears slowly, the reaction then being "delayed" or "biphasic." On the addition of alcohol, a rose-colored azobilirubin is formed; he terms this the "indirect" reaction. The amount of azobilirubin formed in the latter reaction can be estimated colorimetrically and the amount of bilirubin in the circulating blood calculated. Normal human blood contains from 0.5 to 2.0 milligrams of bilirubin for each 100 cubic centimeters, as shown by the indirect reaction. This test permits the exact estimation of the degree of bilirubinæmia.

Van den Bergh has investigated the point further and believes that chemically pure bilirubin, and that obtained from the gallbladder and bile passages, are somewhat different substances. The direct reaction is only given by the latter, whereas the former requires the addition of alcohol for the development of any color whatever. He interprets this as the result of changes in the substance, probably occurring during its passage through the polygonal hepatic cells. By adapting van den Bergh's view to his own theory, McNee (15) has suggested that a direct reaction is diagnostic of obstructive jaundice, that the indirect reaction is obtained in all types, as well as in normal human serum, and that a biphasic or delayed type of direct reaction would be expected in cases of jaundice of toxic or infectious origin.

In the experience of many continental investigators this differentiation seems to work out fairly well. My own studies with the method are not so conclusive. Without discussing the matter in too much detail, it would seem that direct reactions are obtained in high degrees of jaundice from whatever cause; possibly increased viscosity of bile with the formation of obstructing bile thrombi (as suggested by Eppinger, 8) may play a part. I have also noted the accumulation of bilirubin giving the indirect reaction in animals with obstructive jaundice prior to the appearance of the direct reaction. I have felt that a sharp differentiation of obstructive and non-obstructive jaundice was not always possible on the basis of van den Bergh's test alone; the time-honored examinations of the urine and stools for bile pigment are still of great value in this connection. The quantitative estimation of bilirubin in the blood, however, is of the greatest clinical and scientific value.

The retention of substances other than bilirubin complicates the clinical picture of jaundice caused by occlusion of the biliary passages. Chief among these other constituents of bile are the bile acids, glycocholic and taurocholic; their effect on the organism is undoubtedly most important. The present knowledge of the physiology of bile acids is very limited; they are, however, probably formed exclusively by the hepatic cells. Their cholagogue

action is well known; some evidence exists to show that they are reabsorbed from the intestine and act in this way as a stimulus to the further production of bile.

The effect of the retention of bile acids on the organism is very imperfectly understood. Cholic acid is known to be toxic; it acts on heart muscle similarly to digitalis, and may also cause degeneration of the renal tubules. Macht and Hyndman have suggested that the toxicity of bile may depend on the cholic fraction of the bile acids. French clinicians have attributed the bradycardia and pruritus observed in cases of jaundice to these acids.

The whole subject of the metabolism of bile acids and their precise effect on the organism in cases of jaundice remains uncertain pending the perfection of a method for their quantitative determination on the blood. Aldrich, Rowntree and Greene, of the Mayo Clinic, and McNee (14) have independently evolved such methods, and are at present engaged in further studies.

The conception of dissociated jaundice, that is, a selective retention of either bile acids or bile pigments, is to be attributed to men of the French school, notably Brulé, Chauffard and Widal. Their conclusions were based on the study of the products of the metabolism of bile in the stools and urine, and consequently are not entirely conclusive. Hoover and Blankenhorn reviewed much of this work in 1916; they attempted a study of these substances in the blood stream, and described retention of bile acids in cases of primary anæmia and lead poisoning without any retention of bile pigments. A further review of this whole subject, newer methods being used, would be of great clinical interest.

The clinical importance of these new conceptions of jaundice has only recently been properly appreciated. Recent knowledge of the mechanism by which jaundice is produced, together with van den Bergh's method of studying the bilirubin content of the blood, has been of much value in clarifying a number of obscure points with regard to hepatic disease. The recognition of latent jaundice, obviously a most important point, has also been made possible by this method. Previously the only reliable aids were the scleral color, and the presence of bile in the urine. A serum bilirubin content of from 3 to 5 milligrams is necessary before the urine gives the usual tests for bile in cases of obstructive jaundice; in cases of hæmolytic jaundice considerably larger amounts may be present without any passing through the kidney. A threefold to fivefold increase in the serum bilirubin is necessary for the production of clinically demonstrable icterus. A number of recent observations tend to establish the belief that the affinity of body cells generally for bilirubin is not great, the quantity of the pigment present in jaundiced tissues remaining relatively low and constant in spite of wide fluctuations in the quantity in the serum. These facts demonstrate the obvious advantage of the direct study of the blood in cases of jaundice.

Van den Bergh's test, therefore, will furnish earlier and more accurate information regarding the onset of jaundice than any other means at the physician's command. The clinical value of the test has been emphasized by van den Bergh, de Takáts, and others. In my experience it has aided in the recognition of hepatic congestion in cases of early myocardial failure, in the differential diagnosis of anæmia due to destruction of blood, in the identification, in some instances, of a typical gall-stone colic, and in the early demonstration of jaundice following obstruction of the common duct. Carotinæmia may also be distinguished from jaundice by this means. The test is also useful to the surgeon as a quantitative measure of jaundice, aiding materially in the selection of a time for operating on patients whose jaundice may be increasing or subsiding. Its value in this capacity has been particularly emphasized by Judd, who also considers it a most valuable aid to prognosis. Finally, fluctuations in the content of bilirubin in the serum may be significant in distinguishing jaundice due to stone in the common duct with partial obstruction from the progressively increasing type seen in pancreatic carcinoma and stricture of the common duct.

The pathological changes in the liver associated with jaundice have been widely discussed. The reaction of the liver to toxic or bacterial injury is a proliferation of connective tissue, with subsequent cirrhosis. The degree

and type of cirrhosis depend on the virulence of the toxin and its method of entry. Obstruction of the common duct produces biliary cirrhosis with the primary proliferative changes occurring in the region of the biliary capillaries; the cirrhosis due to alcohol, copper, pepper and other irritants absorbed from the intestinal tract by way of the portal vein shows a primary change in the vicinity of the portal capillaries.

In cases of toxic or infectious jaundice, the initial damage occurs in the polygonal hepatic cells themselves, all degrees of pathological change from simple cloudy swelling to actual necrosis being observed. The portal spaces and biliary capillaries are only secondarily affected. The relationship of cirrhosis to jaundice of this type is obviously of great clinical interest. McNee (14) and others have suggested that all the changes observed in such conditions, ranging from simple hepatitis to acute yellow atrophy and cirrhosis of high grade, are all part of the same pathological process. This point is well illustrated by the hepatic changes observed in syphilis. The combination of salvarsan and syphilis may produce all of these grades of hepatic damage, from the mildest to the most severe. Cases have been observed to progress from the stage of mild transient jaundice to a terminal *hepar lobatum* with ascites. Exactly similar observations have been made in cases of poisoning with trinitrotoluene and tetrachlorethane, the pathological process progressing gradually over a period of years. I have had the opportunity of studying several cases of toxic jaundice of unknown origin in which no obstruction of the bile passages could be demonstrated; in these cases the development of definite cirrhosis was confirmed by biopsy made at the time of exploration. The conception of a progressive hepatitis, with variable degrees of jaundice, and increasing cirrhosis is of the greatest interest to the surgeon and internist.

Continental physicians, notably Eppinger (9), have been much interested in the relation of the reticulo-endothelial system to hepatic and splenic disease. The cirrhosis associated with splenomegaly, Banti's disease, and certain types of biliary cirrhosis have been considered as "liver-spleen diseases" (9), and the improvement following splenectomy explained on the basis of a removal of a functional overload on the liver. W. J. Mayo has said that certain splenic diseases, involving as they do the reticulo-endothelial system, may cause the elaboration of toxic substances which, when carried to the liver by the splenic vein, produce splenic types of hepatic cirrhosis. He has also demonstrated that splenectomy is of considerable benefit in selected types of biliary cirrhosis, as well as in portal cirrhosis associated with ascites.

Prolonged coagulation time has long been known to be a fairly constant finding in cases of obstructive jaundice, and hæmorrhage was formerly one of the most feared postoperative complications, as well as the chief cause of a high surgical mortality. The use of calcium chloride intravenously, as advocated by Walters, has served to reduce very greatly the occurrence of such hæmorrhages. Since the general adoption of his method, there has also been a marked decrease in operative mortality following surgical procedures in jaundiced patients. The cause of prolonged coagulation time in cases of icterus still remains obscure. In cases of both clinical and experimental obstructive jaundice it is known that the serum calcium is constantly within normal limits, while the blood fibrinogen content is normal or even increased. It has been suggested that a chemical union between the blood calcium and some constituent of the retained bile may exist, rendering the calcium inert and incapable of performing its usual function in the coagulation of blood. Such a union, however, has not been satisfactorily demonstrated.

A recent revival of interest in studies of hepatic function has resulted in a number of interesting observations on its relation to jaundice. A group of us at the Mayo Clinic (10, 11, 30) has recently made a survey of the subject, and studied certain of the more promising tests of hepatic function in cases of experimental and clinical obstructive jaundice. In the experimental series a number of these tests were performed on dogs following ligation of the common bile duct; cholecystectomy was combined with ligation of the common duct in half of the animals used, in order to hasten the development of icterus. In both groups the

hepatic functions relating to carbohydrate and protein metabolism were somewhat, but not seriously, altered. Diminished formation of urea, as shown by sharp decreases in the blood urea and non-protein nitrogen, occurs almost at once after operation. Uric acid, however, did not accumulate in the blood as it does in dogs after hepatectomy. An impairment of carbohydrate metabolism, as evidenced by decreased fructose tolerance, developed from 6 to 11 days after the onset of jaundice. The fasting level of the blood sugar usually remained within normal limits, although moderate hypoglycæmia, which did not respond to the administration of fructose, was noted in two animals before death.

In the clinical series similar but somewhat less definite results were noted. In about half of the cases studied the fructose tolerance was lowered. Blood urea values showed, on the average, a slight decrease, but did not in any case fall below the lower limits of normal. In brief, the failures of carbohydrate and protein metabolism, which characterize Mann's dehepatized dogs, were not approached in either the clinical or experimental series. This perhaps is to be expected in an organ with so large a factor of safety as the liver.

From the standpoint of treatment, however, the impairment of carbohydrate metabolism is of considerable importance. It has long been known that a high carbohydrate diet protects the liver very effectually against experimental toxic injury. Mann (18) has found that feeding glucose has greatly increased the period of survival of animals after the induction of obstructive jaundice. These two points have been utilized clinically in the postoperative management of patients with long-standing obstructive jaundice presenting the syndrome of hepatic insufficiency described by Walters and Parham. In a number of such cases observed at the clinic the intravenous administration of glucose has been a most effective method of treatment, producing remarkable and permanent improvement in several practically moribund patients.

The excretory functions of the liver, as measured by the use of dyes, show much more definite impairment in cases of obstructive jaundice than those related to carbohydrate and protein metabolism. The results of the Rowntree-Rosenthal phenoltetrachlorphthalein test in both the experimental and clinical series already mentioned were very striking. In animals, maximal retention of dye was observed 24 hours after cholecystectomy and ligation of the common duct. In animals whose gall bladder had been left intact, jaundice and retention of dye developed somewhat more slowly. In both groups of animals, however, the level of serum bilirubin on successive tests was almost exactly parallel to the degree of retention of the dye, suggesting a possible relation in the manner of excretion of the two substances. In patients with obstructive jaundice the same striking parallelism of bilirubinæmia and retention of dye was observed. The uniformity of this finding did not appear to be influenced by the duration of the jaundice or the etiological agent involved. Rosenthal, using phenoltetrachlorphthalein, and Delprat, Epstein, and Kerr, using rose bengal, have demonstrated dye retention in patients with obstructive jaundice; their results are similar to those obtained at the clinic (10, 11, 30).

These observations naturally raise the question of the accuracy of conclusions based on the dye tests for liver function when applied to gross pathological changes in the presence of icterus. It is certain that the hepatic parenchyma is greatly damaged by long continued obstructive jaundice, and retention of dye is therefore to be expected. In fact this retention persists in such cases long after obstruction of the common duct is relieved. In obstructive jaundice of short duration, however, no very definite morphological changes can be demonstrated although dye tests may indicate maximal retention.

Rous and Drury have recently shown in experiments on animals that the liver is unable to take up the dye sodium indigotate after prolonged chloroform anæsthesia, and that during this period of temporary dysfunction bilirubin is not secreted by the liver. They have further demonstrated that the dye is not absorbed by the liver within so short a time as 24 hours after ligation of the common duct. The interpretation of such findings is difficult; the possibility of functional impairment of the

hepatic cells, and likewise that of a chemical combination between the bilirubin and the dyes used, or of their combination with some other substance, must be considered.

In an effort to cast further light on the problem, I have recently administered quantities of bile, intravenously to dogs, using amounts considerably less than the lethal dose. During the period of injection and for a short time thereafter there is a high percentage of retention of dye. Within 24 hours the normal hepatic function of excreting dye will be resumed. Serial sections taken during and after these injections show practically no demonstrable morphological change in the liver cells.

The experimental findings must be taken into account in the interpretation of tests involving the excretory function of the liver, particularly when jaundice is present. The clinical value of dye tests for hepatic function is unquestioned; the data presented are intended simply to call attention to certain of their known limitations. It is apparently not justifiable to reckon hepatic damage when produced by jaundice, particularly if it be of the obstructive type, in terms of retention of phenoltetrachlorphthalein alone; the clinical aspects of the case in question must be carefully reviewed. The analogy of diminished excretion of phenolsulphonephthalein and increased blood urea in prostatic obstruction may help to illustrate this point. One expects a rapid return to normal as the obstruction is relieved, provided renal damage has not been too great. An entirely similar phenomenon is observed in cases of obstructive jaundice after drainage of the common duct is established. A failure of excretion of bile pigment after operation has almost exactly the same significance as a decreasing output of urine after prostatectomy.

In conclusion it may be said that our new knowledge of the physiology of the liver, particularly that relating to jaundice, has produced a definite improvement in the diagnosis and management of hepatic disease. Physiological and chemical knowledge relating to jaundice has been put to practical use. Much remains to be done along experimental lines, the fields of the metabolism of bile acid and cholesterol remaining practically untouched. The field for new tests for hepatic function, and for a study of those already available with a view to their better interpretation, is attracting the attention of investigators.

Difference of opinion between pathologists and clinicians has added to the general confusion regarding the classification of hepatic disease. It is encouraging to know that new classifications, involving the more recent additions to our knowledge of the subject, are in project. The general interest augurs well for a better understanding of one of the most complex and difficult fields of medicine.

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APPENDICITIS IN INFANCY AND CHILDHOOD

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From Milwaukee Children's Hospital

FROM May 20, 1913, the earliest date from which accurate records are available, to December 31, 1924, 8,973 patients were admitted to Milwaukee Children's Hospital. During this period 61 operations for appendicitis were performed. The cases were fairly equally divided among five surgeons who were on the active service at different periods. Five patients died, making the mortality for this series 8.2 per cent.

In the following table the 8,973 patients are grouped according to age, and the number of cases of appendicitis occurring in each yearly group is shown.

It will be noted in Table I that none of the patients with appendicitis was under 2 years of age, 12 were between the ages of 2 and 8, and 49 were between 8 and 13. Other series bear out this apparent rarity of appendicitis in infancy. Abt, in 1917, could find only 80 cases in patients under two, reported in the literature. Several reasons are advanced to explain the fact that appendicitis is rare in the first few years of life. It is thought that the liquid diet, the absence of hard fæcal concretions and the frequency of bowel movements have some influence, as has the supine position in which the infant spends most of its time.

TABLE I.—PATIENTS ADMITTED TO MILWAUKEE CHILDREN'S HOSPITAL BETWEEN MAY 20, 1913, AND DECEMBER 31, 1924, AND NUMBER OF PATIENTS WITH APPENDICITIS IN VARIOUS AGE GROUPS.

Patients with appendicitis		Patients admitted	
Under 1 year	0	1354	0 in 2158 cases
1–2	0	804	
2–3	1	539	12 in 4,003 cases between 2 and 8 years or 1 to 333
3–4	0	630	
4–5	3	598	
5–6	1	722	
6–7	4	780	
7–8	3	734	
8–9	11	752	49 in 2,812 cases between 8 and 13 years or 1 to 57
9–10	8	606	
10–11	9	589	
11–12	11	506	
12–13	10	359	
Total	61	8973	

It is usually stated that appendicitis is more common among boys than girls in the proportion of two to one. This relation is well demonstrated by our series as 41, 67 per cent, of our patients were males, and 20, 33 per cent, were females. The statement is also frequently encountered that the mortality rate is twice as high among girls as boys. Of 5 patients who died 3 were girls and 2 were boys.

Certain characteristics of appendicitis in infancy and childhood are emphasized by all writers. Most important are the obscurity of the symptoms in early life with a gradual transition to the classical adult picture with increasing age, the rapidity of the course, and the tendency to perforation with subsequent peritonitis.

In discussing the obscurity of symptoms, Howard Kelly says: "The abdomen of a little child is but a miniature of the adult in the relative approximation of all the organs, and in the close contiguity of those in the pelvis and in the upper abdomen. The boundary lines of the abdomen are approximated. With age and the assumption of the adult form, the organs are separated by a wider interval, their differentiation being thus facilitated." Muller and Ravdin call attention to the fact that many writers erroneously state that the pain in appendicitis in children varies because of the variations in the position of the organ. The appendix receives its nerve supply during embryonic life from the abdominal sympathetic. The sensation of pain, which attends the earliest stage of appendicitis, is referred to the cutaneous distribution of the spinal nerves with which the sympathetic center makes its connections. As a rule, therefore, pain is referred to the region of the umbilicus, the terminal distribution of the tenth and eleventh intercostal nerves. As the inflammation spreads and the peritoneal coats and contiguous structures are involved, the pain is felt in the right iliac fossa or wherever the appendix may be located. It is this second-

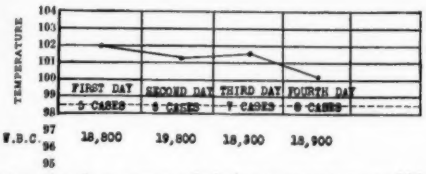

Chart showing average admission temperatures and blood counts of 26 patients with ruptured appendices. The number of days following onset of symptoms and the number of patients entering on that day are shown.

ary pain which tells us the location of the appendix.

It is common of many diseases in early life, upper respiratory and intestinal infections for example, to be ushered in by nausea, vomiting, fever, and abdominal pain. Vomiting occurred in 44 of our cases and was present in all but 3 of the 36 patients with ruptured appendices. Constipation is a symptom of value in the diagnosis of appendicitis and when it is present in association with the foregoing symptoms, appendicitis should be considered a probability. McManus gives the rule that in patients over 4 with constipation, other things being equal, the condition is probably appendicitis, while in patients under 4, with diarrhœa, the condition is probably gastro-enteritis. Twenty-four of our cases gave a history of constipation and only 6 a history of diarrhœa. Pain on urination was noted in 10 cases.

The average admission temperature of patients with acute appendicitis, unruptured, was 100.8, the average temperature of patients with ruptured appendices and a spreading peritonitis was 101. The maximum and minimum temperatures for acute appendicitis were 104 and 98.8, and for ruptured appendicitis were 104 and 98.

The average leucocyte count for the entire series was 17,500; the average count in acute appendicitis, unruptured, was 15,500; the maximum and minimum counts being 25,100 and 9,800. The average leucocyte count in the acute cases, ruptured, was 19,000, the maximum and minimum being 39,600 and 11,200. It would seem from these figures that the leucocyte count is somewhat more reliable in indicating the degree of involvement than is the temperature, and one is reminded of the statement of Zachery Cope that a normal temperature does not mean a normal peritoneum (Chart).

Fixation of the abdomen during respiration is a striking sign when there is a spreading peritonitis present. Tenderness is difficult to interpret in many instances and it requires tact and patience to elicit this symptom in such a manner as to be satisfactory. Rigidity of the abdominal muscles was noted in 45 of our cases and was not absent in any case in which the appendix was ruptured. Because of the shallow pelvis of the child rectal examination reveals evidence of value much oftener than it does in the adult.

The fulminating character of appendicitis in children is evidenced by the fact that in 36 of the 61 cases, 59 per cent, the appendices were ruptured. The patients with ruptured appendices entered the hospital on the following days after the onset of symptoms.

TABLE 11.—NUMBER OF DAYS AFTER ONSET OF SYMPTOMS. CASES OF RUPTURED APPENDICES ENTERED

Day	Patients
First	5
Second	6
Third	8—one died
Fourth	7—one died
Fifth	1
Sixth	2—one died
Seventh	0
Eighth	1—abscess
Ninth	0
Tenth	1—died
Eleventh	0
Twelfth	0
Thirteenth	0
Fourteenth	3—one died, general peritonitis; two had localized abscesses.
4 weeks	2—abscess formation in both.
Total	36

11, 30 per cent, ruptured in the first 48 hours.

18 per cent of the entire series ruptured in the first 48 hours (61 cases).

Eighteen per cent of the entire series had ruptured appendices in the first 48 hours, and considering the cases with ruptured appendices as a group, in 30 per cent rupture occurred in the first 48 hours. The average entrance day for the cases of acute appendicitis with unruptured appendices was the second day, while the cases of appendicitis with ruptured appendices entered the hospital, on an average, 3½ days following the onset of symptoms.

It is a truism to say that in acute appendicitis in infants and children, the prognosis depends on proper and early diagnosis and prompt surgical intervention. In spite of the difficulties which have been enumerated, careful analyses of symptoms and signs leads to a surprisingly high percentage of correct diagnoses. In the treatment of appendicitis it has been the policy of the surgical section of this hospital to advise operation in all but obviously moribund patients. Even in desperate cases the results of operation have been at times most gratifying. In infants, the omentum is a thin, short, transparent structure, plainly not involved in the localization of infection. It gradually increases in size and length, and in older children is occasionally seen near the appendix and at times is wrapped around it. The peritoneum in infancy and childhood is also less resistant to infection than in the adult. In children vomiting from intra-abdominal disease, dehydration is rapid, and the general bodily reserve which may be utilized to combat infection is soon exhausted. In several instances, children apparently in desperate condition, have been transformed to hopeful cases in a few hours by operation. The change in the facial expression in some of these patients is especially striking. We believe that the expectant plan of treatment has an extremely limited field of application in appendicitis in infancy and childhood.

The cases here reported represent all cases of appendicitis seen at this hospital during the stated period with only three exceptions which are the following: Two patients, both girls, aged 9 and 10, had mild attacks and were discharged from the hospital as improved. Operation was advised in both cases but was not done because the parents refused in one instance, and because of severe illness in the family of the other. The third patient listed as appendicitis came to the hospital with a two-day history of pain in the abdomen, vomiting, and sore throat. The temperature on admission was 103.4 and there were rigidity and tenderness over the lower right abdomen. Within a few hours after admission a typical scarlet fever rash developed and the patient was sent to the isolation hospital.

TABLE III.—MORTALITY RATES IN APPENDICITIS IN CHILDREN QUOTED BY VARIOUS AUTHORS.

	Per cent	Cases
Alexander	3	500
Muller and Ravdin	6.8	58
Beekman	7.8	...
Simpson	14.7	34
Mitchell	24	*40
Gray and Mitchell	15	†200

*Spreading peritonitis
†126 acute

Our mortality rate of 8.2 per cent reflects the improvement in treatment and diagnosis which is evident in more recent series. In 80 cases under 2 years of age, collected by Abt in 1917, the mortality was over 50 per cent. Only 46 of these patients were operated on, the operative mortality being 30 per cent. The mortality rate among patients not operated on was over 90 per cent. The following mortality rates shown in Table III are representative of those in the recent literature.

It is to be noted that of our patients who died all had ruptured gangrenous appendix with spreading peritonitis. One death occurred on each of three services and two on one other. The earliest day of admission following the onset of symptoms in fatal cases was the third. One entered on the fourth day, one on the sixth day, one on the tenth day, and one on the fourteenth day following the onset. The fact that no deaths occurred among the patients with ruptured appendices operated on prior to the third day is merely an added bit of evidence for early intervention. Our patients who died were all desperately sick, and it is fair to assume that operation gave them their only chance for recovery. It is fair to assume also that several of the patients operated on after the first 48 hours and who recovered, would have died but for operation. In other words, by refusing to operate on these desperately sick cases, one may improve his operative mortality statistics, but taking all cases of appendicitis entering a hospital as a group, fewer patients will be discharged alive and well if this policy is followed than by operating on all cases except those *in extremis*.

In addition to advocating operation in practically all cases we believe that the McBurney muscle-splitting incision is not only the

incision of choice, but that it is a great factor in reducing intra-abdominal manipulation and postoperative shock. Time is an important element in the operation and should be conserved by any means consistent with safety. This incision gives bloodless access to the peritoneal cavity in 1 to 2 minutes, and in closing the wound in serious cases, a stitch or two suffices. The degree of operative shock is directly proportional to the amount of small intestine exposed and to the amount of trauma inflicted. It is not unusual, when doing appendectomy through this incision, to see only a small portion of the terminal ileum. In cases with ruptured appendices with spreading peritonitis the system of drainage which we employ consists of placing a large sized, split rubber tube with gauze to the bottom of the pelvis and a cigarette drain to the right kidney fossa, both through the original incision.

The importance of the subcutaneous administration of normal salt solution in the postoperative management of these cases cannot be overemphasized. The dehydration resulting from vomiting and abstinence from food and water causes young children to wilt rapidly. As a rule, it is not practicable to administer continuous hypodermoclysis, but several hundred cubic centimeters can be given repeatedly. We have found codeine to be an efficient and safe sedative and believe that it should be used in doses sufficient to relieve pain, especially during the first 48 hours after operation. One of the most important and most serious postoperative complications is acute intestinal obstruction. When this occurs prompt intervention is imperative, but one should guard against extensive operative procedures. The suture of a catheter into a loop of distended bowel is frequently all that these patients will stand, and fortunately this operation not only relieves the symptoms of obstruction but it is often unnecessary to do anything more.

SUMMARY

1. Appendicitis is rare in the first 2 years of life.

2. There is a tendency to early perforation in appendicitis occurring in children.

3. With few exceptions, appendicitis in early life should be treated surgically at whatever stage the patient is seen.

4. The McBurney incision is the incision of choice because it gives rapid and bloodless access to the appendix and as a rule very little intra-abdominal manipulation is required when this incision is used.

5. Dehydration is an important factor and should always be considered in the pre-operative and postoperative management of these children. It is best combated by the subcutaneous administration of fluids.

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ACQUIRED SUPPURATIVE DIVERTICULITIS WITH PYLEPHLEBITIS AND METASTATIC SUPPURATION IN THE LIVER

Report of a Case

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ACQUIRED diverticula have only recently received ample attention in the literature. The condition is quite uncommon although not rare, and it is not so long ago that it was considered a mere pathological curiosity. Quite a large number of case reports have appeared in the past 25 years which have established the importance of the condition because of the secondary pathological processes which are apt to occur. As recently as 1917 Telling (3) was able to find only one case of metastatic suppuration secondary to diverticulitis which was recorded by Whyte (4). Whyte's case was one of suppurative diverticulitis with metastatic abscesses in the liver. Clinically and pathologically his case was practically similar to ours, although he was unable to obtain a positive blood culture during life and necropsy failed to reveal gross evidences of pylephlebitis. In 1921 Foggie (2) reported a case of abscess of the brain secondary to diverticulitis, and at that time claimed that his case was the second on record of distant suppuration from this cause. Careful search of the literature since has failed to reveal any other similar case. It appears, therefore, that our case is the third on record of diverticulitis with metastatic suppuration, and the first with pylephlebitis.

INCIDENCE

In 13,069 necropsies performed at the Dresden City Hospital, Johns Hopkins Hospital, Boston City Hospital, and the Bender Hygienic Laboratories there were found 39 cases of congenital (Meckel's) diverticula, 16 instances of acquired diverticula of the small intestine, and 28 cases in the large gut. Diverticula are usually multiple and are found most frequently in the large bowel especially in the lower part of the descending colon and sigmoid flexure. The sacs occur on the side of the gut or close to the mesenteric attachment, although they are found on the convexity in rare instances. The size varies from mere macroscopic visibility to that of a hazelnut. They rarely attain a larger size since secondary pathological changes are very apt to supervene.

ETIOLOGY

The question has arisen whether this condition is congenital or acquired. It appears very significant that no case has occurred in a child, the lowest reported age being 22 years. Although the anatomical arrangement of the muscle fibers and connective tissue of the vessel spaces furnishes a predisposing factor, it appears likely that the condition is acquired. The average age is about 60 years and the occurrence is about twice as frequent in males. Because of the presence of fatty tissue in the bowel wall, obesity may be a factor. The physiological rôle of the sigmoid with its retention of fæcal matter and gas is stated to be important, as is muscular deficiency of the gut wall associated with constipation and flatulence. It is evident that the spots where the gut is pierced by the vessels are areas of weakened resistance to internal pressure. Vascular dilatation incident to passive congestion of heart failure may further weaken the vessel spaces by pushing aside the muscle fibers. It is probable that no one factor is sufficient, but that several or all co-exist.

PATHOLOGY

There is no trouble until secondary pathological changes occur. The first tendency is toward progressive enlargement of the sac, which leads early to atrophy of the muscle layers and the glands of the mucosa. The irritation of the contained hardened fæces results in dangerous thinning of the sac and inflammatory changes which may be slight or may lead to serious acute or chronic lesions. Acute gangrenous inflammation of diverticula

has, of course, been described, as has acute peritonitis of a general or localized nature. When perforation occurs, the results depend on the acuteness of the ulcerative process, the amount of chronic inflammatory thickening and the presence of adhesions. Chronic proliferative inflammation of the submucous and serous coats of the bowel may lead to tumor formation and stenosis with obstruction. This chronic sigmoiditis resembles carcinoma clinically and pathologically, and has undoubtedly been mistaken for malignancy by surgeons at operation and by pathologists at necropsy. The protective adhesions which may be formed in the course of slow inflammation may involve the small bowel giving rise to acute or chronic intestinal obstruction. On the other hand, they may become attached to the bladder with the formation of a vesicocolic fistula. Chronic sigmoid mesenteritis with much inflammatory thickening may give rise to twists, kinks, or volvulus. Lodgment of foreign bodies within the diverticula, carcinoma secondary to diverticulitis, perforation into a hernial sac and metastatic suppuration have also been reported.

SYMPTOMS

The clinical manifestations based on the foregoing pathological survey must necessarily be very varied. Many cases are identical with an acute appendicitis except that the trouble is on the left side. Left-sided tumor and abscess formation are striking features. Some cases are found to have intestinal obstruction in any of the various forms. These are often confused with carcinoma even after the abdomen is opened, when of course the recognition of the true pathology is of great importance. Perforative peritonitis or vesicocolic fistula may be the clinical findings with no suspicion of diverticulitis as the underlying cause. Our case is an example of metastatic suppuration in which no thought of diverticulitis was entertained.

DIAGNOSIS

The diagnosis is very difficult and is rarely made. Since the appreciation of the incidence and possible occurrence of a lesion is necessary for its diagnosis, diverticulitis must be borne in mind by every surgeon who attempts to diagnose and treat abdominal lesions. If the surgeon recognizes the varied pathological pictures and remembers that the condition may resemble clinically almost any acute or chronic condition in the abdomen, many lives will be saved.

TREATMENT

The treatment is, of course, surgical and the procedure will depend entirely upon the pathological form which is encountered. If an abscess is found it must be drained and the opening in the bowel closed. If the bladder is involved in a vesicocolic fistula, the organs must be separated and closed by the usual methods. An intestinal obstruction, caused by stenosis of the bowel, may be relieved by inguinal colostomy when more extensive procedures are contra-indicated by the patient's condition. Resection of the sclerosed and stenosed gut may be performed on patients in good condition. In 1915, Beer (1) attempted to treat a case of pylephlebitis by ligation of the portal vein after an attempt to insure adequate collateral circulation by omentopexy and anastamosis between the left spermatic vein and branches of the inferior mesenteric vein. Some such heroic measure would have been necessary in the surgical treatment of our case.

C. H., a colored male, age 68 years, was admitted to the Cook County Hospital, April 22, 1925, on the medical service of Dr. J. G. Carr. The patient stated that he was in good health and free from any complaint until 12 days before admission, when he was suddenly seized with a severe chill lasting about 20 minutes. This was followed by the onset of nausea and vomiting, which occurred 7 or 8 times that day. Pain, in the upper right quadrant, of a dull, aching, sickening quality, intermittent in character and with no tendency to radiation, was noted at the onset. In the days following there were frequent chills associated with fever. The pain continued but was never very severe. Vomiting and nausea did not recur after the first day. Jaundice was not noted by the patient although the color of the urine was dark. The color of the stools was not noticed since constipation was marked during the entire period. Weakness and prostration became more marked as time passed. The patient denied any previous attacks of a similar nature.

The inventory of systems failed to reveal symptoms of a nervous, respiratory, or cardiovascular character. Nocturia and occasional dysuria had been noted for the past year.

The past history revealed a chancre 30 years ago for which numerous courses of antiluetic treatment had been given. A cataract was removed from the left eye about 3 years previous to entrance. The patient denied excesses of any kind.

The physical examination revealed an elderly, well nourished, negro male, acutely ill and quite markedly prostrated. The skin had a peculiar yellowish brown color and there was definite icterus of the sclera and buccal mucosa. The pupils were small and equal in size but the left eye had an old iridectomy scar. The heart and lungs were normal. There was no evidence of free fluid in the peritoneal cavity. The liver was enlarged and was palpated three finger breadths below the costal margin. Marked tenderness and considerable voluntary muscle resistance were present over this area. The remainder of the abdomen was soft and free from any of the signs of peritonitis. No other organs or masses were palpated.

The blood pressure was 121–75. The blood count showed 17,000 to 19,000 leucocytes, during the stay in the hospital. The urine was negative except for the presence of bile. Examination of the blood showed urea nitrogen, 24.28 milligrams per 100 millimeters; uric acid, 2.57 milligrams per 100 millimeters; creatinine, 1.75 milligrams per 100 millimeters. Blood culture, April 23, 1925, showed streptococcus viridans. Wassermann reaction was negative.

X-ray of the gall-bladder region revealed the liver to be enlarged. No shadows of a positive significance were seen in the right hypochondrium.

When admitted to the hospital the temperature was 101 degrees. Subsequently it remained normal or subnormal except for a terminal rise to 99.4. The pulse varied between 80 and 120. The patient continued to grow worse during the next week and 2 days before death sank into a condition resembling cholæmia.

Extract of autopsy record. The peritoneal surfaces are smooth and glistening. There is no peritoneal fluid. The appendix and gall bladder are grossly unaltered except for a few adhesions about the former. There is no obstruction in the common or hepatic bile ducts.

The liver is somewhat enlarged and the edges rounded. The surface has mottled areas resembling small subcapsular abscesses. On cut section the portal radicals, large and small, are filled with thick grey brown pus. There are numerous miliary abscesses in the liver tissue especially about the porta hepatis and the lower margin. The portal vein just before its entrance into the liver is filled with thick pus, which is found in all its tributaries from the intestines, particularly in the inferior mesenteric vein draining the large bowel.

The lower bowel especially the descending colon and sigmoid shows along the mesenteric border numerous diverticula filled with fæcal material. In several areas these diverticula are occluded and suppurating. In connection with these, large dissecting abscesses are found in the wall of the large bowel, some of which communicate with branches of the mesenteric veins. There are no evidences of dilated or thrombosed hæmorrhoidal veins.

Anatomic diagnosis. Multiple fæcal-impacted diverticula of the colon and sigmoid; suppurative diverticulitis with huge intramural abscesses of the colon and sigmoid; suppurative phlebitis of the mesenteric splenic and portal veins; suppurative hepatitis and cholangeitis; multiple abscesses of the liver; icterus gravis, etc.

This case, in retrospection, presented a typical picture of pylephlebitis. All the cardinal symptoms were present, such as chills, pain in the hepatic region, change in liver dulness, jaundice, picture of marked toxæmia, absence of signs and symptoms of extensive peritonitis, leucocytosis, and positive blood culture. However appendicitis or hæmorrhoids were never even suggested in the history or findings. It was evident that the patient had a septicæmia and there was every suspicion of suppuration within the liver, but because of the absence of evidence of an intestinal lesion, it was believed that the infection, a virulent suppurative cholangeitis, was probably secondary to cholecystitis.

Pylephlebitis, as a complication of neglected appendicitis, is not a rare occurrence. It is probable that in the future more cases of multiple abscesses of the liver will be traced to diverticulitis. It also would follow that additional cases of pylephlebitis secondary to diverticulitis will appear in the literature since it is a very logical sequence of neglected typhlitis.

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GLYCOSURIA AND PREGNANCY

By HENRY J. JOHN, M.D., Cleveland, Ohio
Cleveland Clinic

GLYCOSURIA is frequently found during pregnancy. It means sometimes that the patient is a diabetic, but usually it signifies only a temporary or an insignificant condition. In the first instance treatment is indicated; in the second no treatment is required. The condition should never be disregarded, however, until it has been definitely determined whether or not it is of diabetic or of innocent origin.

Two cases taken from a larger series will be sufficient to illustrate the problem presented by the presence of glycosuria in pregnancy and the necessary steps for differentiating innocent from diabetic glycosuria.

Case 1. The patient was a young married woman 24 years of age, who consulted me because of the presence of sugar in the urine. There was no familial history of diabetes. During childhood the patient had had measles, diphtheria, and scarlet fever. She had been married 6 years and had two children, the youngest being 5 months old. During her last pregnancy her obstetrician had found sugar in the urine about a month before parturition, but the patient was told that it might be milk sugar and no further attention was paid to the circumstance.

During the 6 months since parturition the patient had had no special symptoms until a week before she consulted me when she began to have excessive thirst and frequency of urination. She consulted her family physician who found a marked glycosuria and prescribed a diet which she had followed for the 3 days before I saw her. At this time her fasting blood sugar was 107 milligrams per 100 cubic centimeters of blood. There was a slight trace of acetone, and the sugar content of the urine was 1 plus. Although her blood sugar was normal when I first saw her, in view of the fact that the patient had had glycosuria just before parturition and had so recently shown definite clinical signs of diabetes, I advised a glucose tolerance estimation which was performed on the following day. The characteristic blood sugar curve of diabetes was obtained as is shown on the chart (Fig. 1, Case 1). It will be noted that the fasting blood sugar on this date was 167 milligrams per 100 cubic centimeters of blood, whereas the day before it was only 107 milligrams per 100 cubic centimeters of blood. The morning urine on the day of the glucose tolerance test showed only a trace of sugar, whereas on the preceding day, although the blood sugar content was lower, the urine sugar was one plus (1). During the glucose tolerance test, the patient took in 100 grams of glucose, and excreted in the urine 16.76 grams.

The practical points illustrated by this case are the following: When glycosuria is discovered during pregnancy it may be, and often is, a sign of the initiation of the diabetic status, when the earliest changes—the hydropic degeneration of the beta cells of the islands of Langerhans—are taking place. If the condition is cared for at this stage, the patient stands a good chance of recovery, of a restoration of the islands to a normal or nearly normal status, as Copp and Barclay have shown by their work with dogs at the Physiatric Institute(2). These investigators undertook to discover the conditions under which the cells of the islands of Langerhans would regenerate. To this end they ablated about four-fifths of the pancreas in each of a group of dogs and let the wound heal, thus rendering the dogs

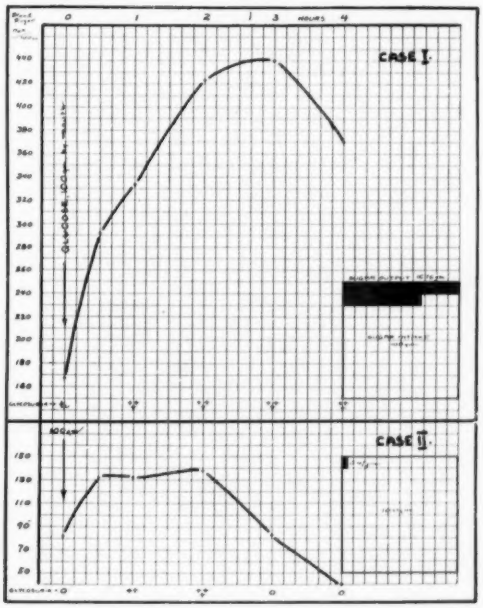
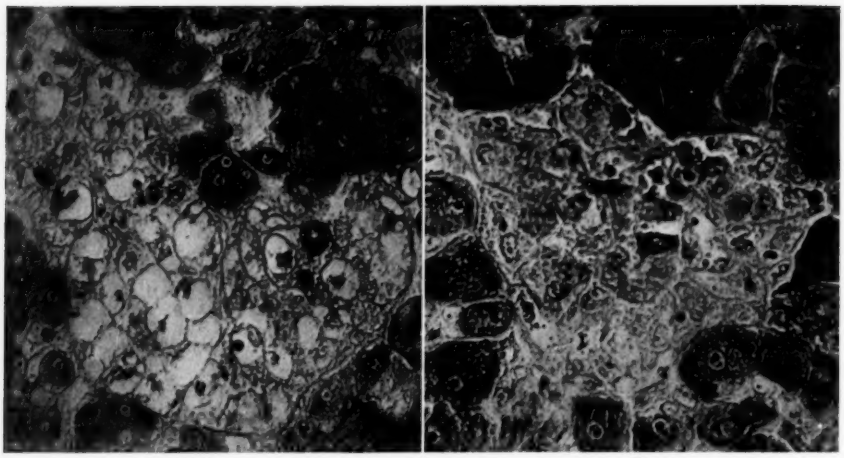


Fig. 1. Chart showing blood sugar curves in Cases 1 and 2.



A. B.

Fig. 2. Photomicrographs of excised pancreas (dog) showing, A, hydropic degeneration of the beta cells; B, restoration of cells of islands of Langerhans. (From Copp and Barclay.)

potentially diabetic. As long as these dogs were kept on a regulated diet, there was sugar in the urine and the blood sugar level remained normal. But when these potentially diabetic dogs were overfed, the blood sugar increased and the dogs began to excrete large quantities of sugar in the urine and to show the signs of general physical failure, such as are exhibited by uncontrolled diabetic patients. After the animals had been subjected to this overfeeding for from 7 to 9 weeks, the authors excised a piece of the pancreas in which they were able to demonstrate the hydropic degeneration of the beta cells (Fig. 2, A).

The dogs were then placed on proper diet and insulin was administered. The urine promptly became sugar free and the blood sugar normal. After they had been subjected to this controlled regimen for from 7 to 9 weeks, again a portion of the pancreas was excised and examined and the cells of the islands of Langerhans were found to be restored (Fig. 2, B).

These findings provide a concrete demonstration of what we have repeatedly seen clinically; that is, that when diabetes is treated early in its development, there is a good chance of restoration of the insulogenic function; but if the treatment is postponed until the islands are gone—fibrosed—nothing will bring about their regeneration.

It is for this reason that when glycosuria occurs during pregnancy, it should never be ignored as a chance occurrence, as due "perhaps to sugar of milk," but the patient should be subjected to a rigid examination to determine the exact status.

As a rule, the diagnosis is quickly and easily made, except in borderline cases, by making a blood sugar estimation 2½ hours after a heavy meal of carbohydrates. If this blood sugar value is 160 milligrams per 100 cubic centimeters of blood, or more, we can safely say that we are dealing with a diabetic patient, in whom, however, the condition may clear up after parturition, provided the condition is properly controlled in the meantime. On the other hand, if the blood sugar estimation in the above test is 90 milligrams per 100 cubic centimeters of blood, or less, then we may know definitely that we are dealing with the renal type of glycosuria which requires no treatment.

CASE 2. This patient was a young married woman 24 years of age, who was in the third month of her first pregnancy. There was no familial history of diabetes. During childhood she had had measles, mumps, chickenpox, diphtheria, and whooping cough; and later in life tonsillitis, grippe, and pleurisy. Ten years before a tonsillectomy had

been performed; and an appendectomy 7 years before.

The patient had been referred to me by her obstetrician who 2 weeks before had found sugar in her urine. The frequency of urination had been increasing, so that when I first saw her she had to get up every 2 hours during the night. When I first saw her, her fasting blood sugar was 73 milligrams per 100 cubic centimeters of blood, and there was no glycosuria. Three days later I made a glucose tolerance test, the results of which are illustrated in the chart (Fig. 1, Case 2). This normal curve shows that we were dealing with a patient with a low renal threshold for sugar, for although the highest blood sugar excursion was 138 milligrams per 100 cubic centimeters of blood, glycosuria was present at the end of the first and again at the end of the second hour. The total output of sugar was but 0.47 grams, in marked contrast to the output of the first patient.

The two cases here described show the two contrasting findings in cases in which glycosuria is present in pregnancy. They show that the glycosuria in itself is but a symptom and is not of final diagnostic significance; but that it calls for further investigation. The first case required treatment for diabetes, while the second case did not require such treatment. On the one hand, to disregard the presence of sugar in the urine in such cases might mean that the patient would be deprived of a vitally needed protection; and on the other, to subject every such patient to the routine treatment for diabetes might mean a dietary restriction and a psychic strain which the patient could and should be spared.

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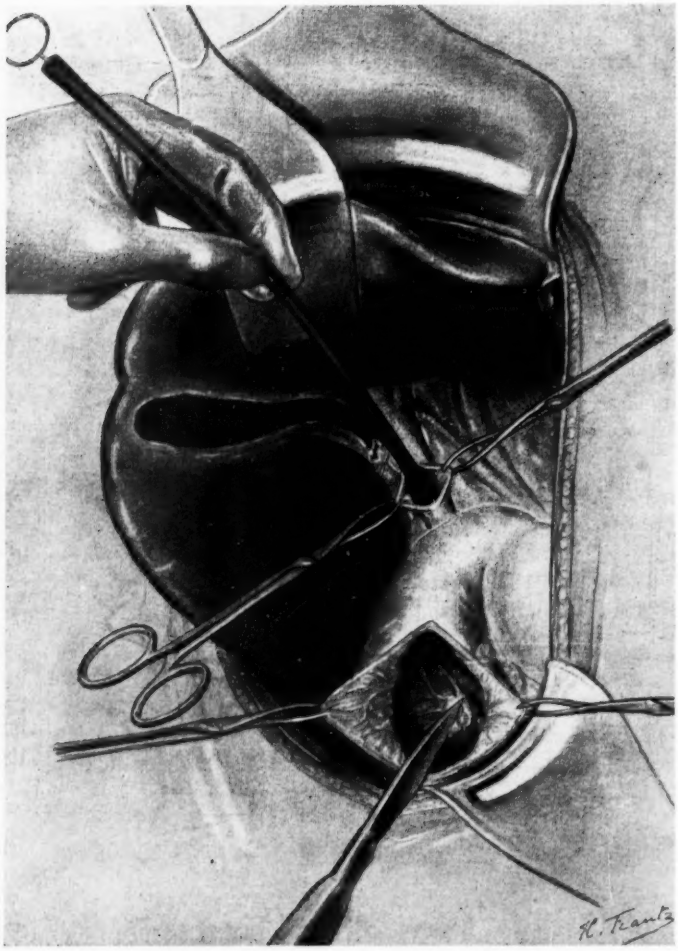

Fig. 5. If there is a calculus in the ampulla of Vater, obstruction of the papilla, the duodenum is opened. The papilla may be incised for the extraction of the calculus or the passage of the drain.

Internal Drainage of the Common Duct.—J. Gatellier

CLINICAL SURGERY

FROM THE CLINIC OF PROFESSOR PIERRE DUVAL

INTERNAL DRAINAGE OF THE COMMON BILE DUCT[1]

By J. GATELLIER, Paris, France
Attending Surgeon, Hôpital de Vaugirard

THE great majority of surgeons institute external drainage of bile after opening the common duct. While drainage of the biliary passage is a measure of necessity, yet it seems illogical to establish external drainage, for if the flow of bile is directed toward the duodenum it is a much more physiological procedure as the bile then follows its natural course. For this reason Professor Pierre Duval considers internal drainage the procedure of choice and believes that it should replace external drainage with the T tube.

DISADVANTAGES OF EXTERNAL DRAINAGE

The principal disadvantages of external drainage are the following:

a. The necessity of packing the liver bed with gauze; the slowness in healing of the abdominal incision facilitating the formation of postoperative hernia; and the forming of peripyloric and periduodenal adhesions which may result in stenosis and cause late digestive troubles.

b. The absence of bile in the duodenum. Although loss of bile through external drainage is only temporary and incomplete, yet there is enough loss to cause disturbance in the digestion of fats and an insufficient utilization of them. The absence of bile is unphysiological. Patients suffering from liver disease are especially in need of all their biological resources to aid in rapid convalescence. The loss of weight and the almost cachectic appearance of patients suffering from a prolonged loss of bile are well known.

Certainly the ideal operation would be choledochotomy followed by immediate suture of the common duct. However, this procedure is not free from untoward, and some times very serious, results. Dilatation of the papilla to assure permanent drainage toward the duodenum, as advised by Moynihan, seems to be more effective theoretically than practically. As to the choledocho-duodenostomy, although successful, this operation has proved to be more dangerous than has duodenal drainage.

PRE-OPERATIVE PREPARATION OF PATIENTS

Patients suffering from obstructive jaundice are subjected to the same type of examination as are patients suffering with all liver diseases and are prepared for operation accordingly. These preparations include tests to determine the blood urea, blood sugar, the quality of blood, and coagulation and bleeding time. An attempt is made to restore as far as possible the biological equilibrium; to regulate the urea level by dietetic measures; to restore normal coagulation and bleeding time by intravenous injections of calcium chloride. Subcutaneous injections of liver extracts are made to furnish a momentary compensation for the functional insufficiency of the liver. Rectal drips of saline with glucose are given in quantities of 1,500 cubic centimeters daily.

The benefit of complete rest—absolute relaxation—should be given to the patient before operation. Enemata are given to empty the bowels thoroughly. Whether jaundiced or not the patient should be operated on when the fever has subsided. Naturally internal drainage can be applied only when none, or hardly any, infection is present in the biliary tract or if a sufficiently long period has elapsed since the last flare-up. In the presence of septic cholangeitis, external drainage should be done.

Careful roentgenographic examination should be made not only to confirm the diagnosis of stone in the gall bladder and common duct but also to detect any possible abnormalities in the

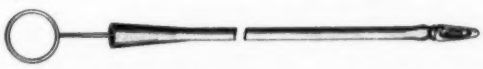

Fig. 1. Drain with fenestrated metallic tube and stylette, for transvaterian drainage of the common duct.

[1]Translated from the French by Geza de Takats, M.D.

Fig. 2. Cholecystectomy, ligation of the cystic duct, supraduodenal choledochotomy. The drainage tube is introduced into the common duct.

duodenal passage. A duodenal stenosis below the papilla of Vater certainly contra-indicates internal drainage.

TECHNIQUE

The technique used by Professor Pierre Duval was recently described in detail.[1]

Incision. Professor Duval does not use the Kehr or Sprengel incision. He prefers to enter the abdominal cavity through a vertical incision which is made at the external third of the rectus muscle and bends slightly at the upper angle toward the midline (Mayo-Robson).

After cholecystectomy and ligation of the cystic duct, a vertical supraduodenal incision is made in the common duct. The duct is probed through this incision with urethral sounds. The papilla is gradually dilated up to the size of a No. 20 bougie. This catheterization is usually very easy. It can be readily noted the moment

[1] Duval, P., et Richards, A. Le drainage duodénal transvaterien par *tube perdu* dans la cholédocotomie. J. de chir., 1925, xxvi, 129.

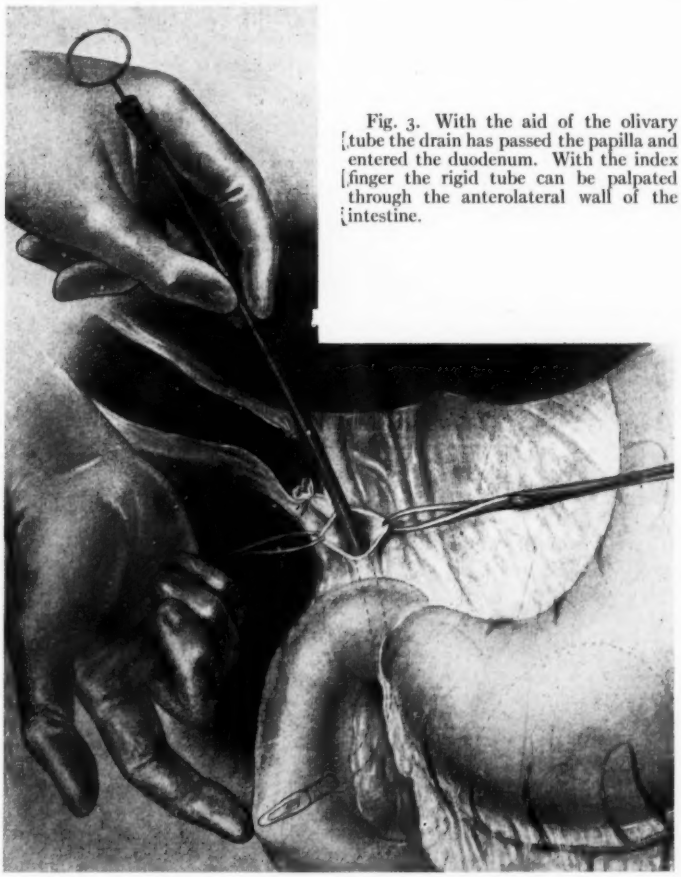

Fig. 3. With the aid of the olivary tube the drain has passed the papilla and entered the duodenum. With the index finger the rigid tube can be palpated through the anterolateral wall of the intestine.

the papilla is dilated sufficiently and the sound passes into the duodenum.

At this stage the drainage tube is inserted. This drain (Fig. 1) is made of rubber and has a metal perforated tip. A metal stylette may be inserted to make the tube rigid.

With the right index finger we lift up the common duct and push the tube in through the opening (Fig. 2). Gradually the sound is pushed in until finally the metal tip disappears behind the pancreas. We then place the right hand on the duodenum and palpate the tip as it enters the bowel. First the metal tip, then the rubber tube passes the papilla. The tube within the papilla produces a circular band which is easily felt. The metal tip can be palpated through the duodenum, and when it is well in place the stylette is removed (Fig. 3).

It is advisable to insert the tip of the drain as far as the third portion of the duodenum. The rubber part is cut long enough so that a small section may be left in the hepatic duct. The common duct is now completely closed (Fig. 4). The liver bed and cystic stump are covered with peritoneum. A rubber drain is placed under the liver; exceptionally, closure without drainage can be done.

It is well to note that in certain cases, in spite of the preliminary dilatation and the presence of a metal tip, the tube becomes stuck at the papilla, curls up, and cannot be made to pass the obstacle. If this occurs the duodenum is opened (Fig. 5). The papilla is then dilated, under direct vision, and may even be incised if necessary. The sound is grasped with a forceps from the duodenum and drawn into its lumen. The duodenum is

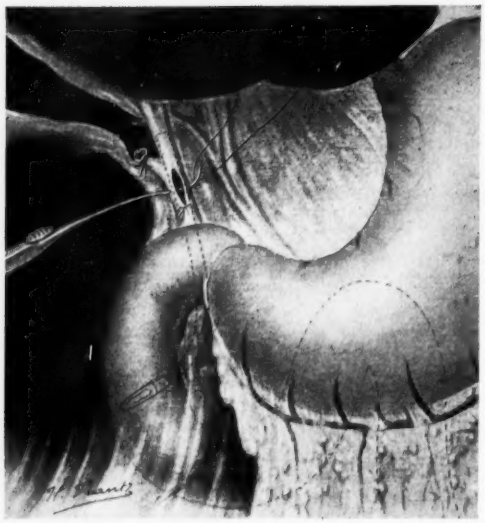

Fig. 4. The upper end of the drain is passed upward into the common hepatic duct. Suture of the common duct.

closed in two layers. This interference is stood perfectly by the patient. In four such cases of Professor Pierre Duval's uneventful recoveries were observed.

POSTOPERATIVE COURSE

The postoperative course is generally undisturbed. A slight escape of bile may be noted through the external tube for the first few days. This tube is ordinarily removed on the fifth or sixth day.

It is advisable to inject liver extracts daily and to administer per rectum 1,500 cubic centimeters of saline with sugar. The duodenal tube is tolerated astonishingly well. Because of the metal tip, evacuation of the tube throughout the intestinal canal can be observed under X-ray. The earliest discharge has been observed on the forty-fourth day. In some cases a much longer time was required. No accident has been noted during the progress of elimination.

When patient is discharged from the hospital, the loss of weight has varied from 2.2 kilograms to 5.4 kilograms. Convalescence is remarkably uneventful.

The notable features of this procedure are the formation of a perfect scar, the absence of hernia formation and of fistula, and the excellent condition of the patient.

SUMMARY

Since April 26, 1924, to January 15, 1926, 41 choledochotomies have been performed in this clinic. Out of these, in 16, duodenal drainage was used, while in 25 external drainage was used. In the 16 cases of duodenal drainage, 1 death occurred. This was due to lobar pneumonia during an epidemic of influenza. The remaining 15 cases made complete recoveries.

The two main advantages of this method are rapidity of recovery and good end-results. Professor Pierre Duval considers this procedure the method of choice in cases of biliary retention, which are not, or only slightly, infected and are in the stage of quiescence.

FROM THE OBSTETRICAL CLINIC OF THE LONG ISLAND COLLEGE HOSPITAL

TECHNIQUE OF TRANSPERITONEAL CÆSAREAN SECTION

By JOHN OSBORN POLAK, M.D., F.A.C.S., Brooklyn
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WHILE it is an admitted fact that throughout this country too many cæsarean sections are being done, it is likewise true that in many of the conservative clinics, too few have been done. At times because of the delay necessary to give the woman a test of labor, this conservatism has cost not only the life of the child, but because of the consequent starvation and exhaustion incident to this test, has contributed to the high maternal morbidity and mortality attending late section.

After a woman has become exhausted, a condition which is evidenced by her restlessness, rise in pulse and temperature, molding of the uterus, and gaseous distention of the abdomen, section is fraught with great danger. However, this danger may be minimized by the following steps which are employed as routine in our clinic in handling cases of dystocia.

1. Pelvic disproportion or fetal malposition should be recognized either before or immediately at the beginning of labor. This presupposes some prepartal study, as for instance, the determination of the size of the pelvis, the relative size and position of the head, its malleability, the inclination of the brim and the axis and direction of the uterine drive.

These points are readily recognized in the case of actual contraction. It is, however, the

2. Borderline case in which there is but slight disproportion with perhaps nothing but slight deflexion of the vertex, that requires the greatest obstetric judgment. Since over 80 per cent of labors in borderline contractions terminate spontaneously, or by the aid of low forceps, it is well in these cases, to allow the woman to have a moderate test of labor—this is best given in bed, conserving her strength by rest, the free use of morphine and scopolamine, forced feeding, and the forced in-

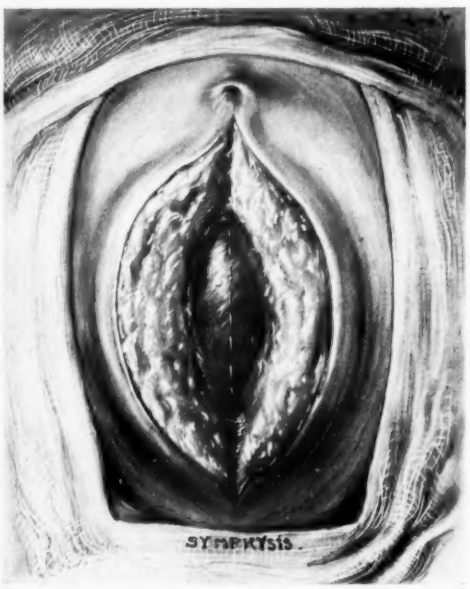


Fig. 1. A median incision is made through the skin, fat, and rectus fascia, showing dusky peritoneum over pregnant uterus.

Fig. 2. *A*, Traction stitch. *B*, Separating bladder reflexion. Incision walled off with gauze packs. This case had a very low bladder attachment.

Fig. 3. Bladder retracted downward. Incision through uterine wall.

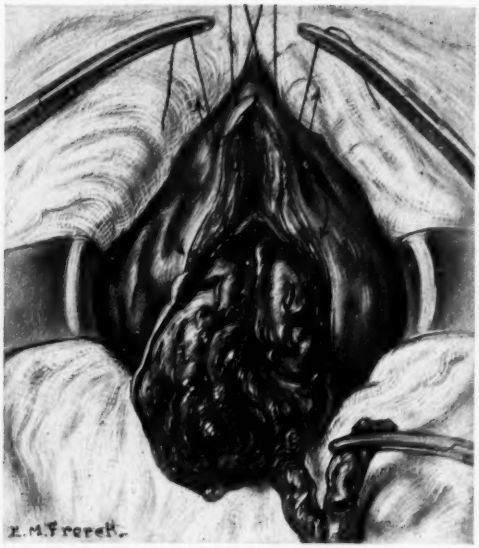


Fig. 4. First row of stitches through uterine muscle, rolling edges together and helping to express placenta.

gestion of fluids. During this preliminary test, the character of the contractions, the contour of the uterus, the pulse, temperature, and progress in descent and amount of dilatation are carefully checked. Should there be no evidence of advance as is shown by the arrest of the presenting part or no apparent gain in the amount of dilatation of the cervix, a careful vaginal examination with the bladder empty should be done, and an attempt made to crowd the perfectly flexed head into the brim; if there is much overriding, or if the consistency of the head and sutures show that it cannot be crowded in, the case should be subjected to section.

PRE-OPERATIVE PREPARATION

The patient to be sectioned should have a short period at least of pre-operative physical and mental rest. This may be secured by giving her 1/6 grain of morphine and 1/200 of a grain of scopolamine three-quarters of an hour to an hour before the time set for operation, and if she has been subjected to a test of labor, as above described, she should also have an intravenous injection of 250 cubic centimeters of a 10 per cent glucose solution prior to anæsthesia. Morphine and glucose preserve tissue waste.

After the vulva has been clipped of its hair, and the vulva and inner surfaces of the thighs have been thoroughly scrubbed with soap and water 1 ounce of a 4 per cent solution of mercurochrome should be slowly injected into the vagina while the patient has her hips elevated on a sterile douche pan. This should be done at least 30 minutes before she is sectioned, and is particularly necessary when the membranes are ruptured. The vulva and inner surfaces of the thighs should also be painted with this solution. The woman is then catheterized and the abdomen prepared in the usual manner with a 3½ per cent iodine solution which is applied over the entire skin surface of the abdomen, from the ensiform to the pubis and is allowed to dry. Local anæsthesia supplemented with gas-oxygen gives sufficient relaxation.

OPERATION

The patient is now draped with sterile towels and a median incision below the umbilicus is made through the skin and fat, exposing the anterior sheath of the rectus muscle; another knife is now employed to incise the fascia as near the median line as possible. The fascia is opened to the full length of the wound, which allows the rectus muscle to be displaced outward and the posterior sheath of fascia with the attached peritoneum grasped between two Kelly clamps and divided. This incision in the posterior fascia and peritoneum is also extended to the full limit of the wound. This exposes the lower segment of

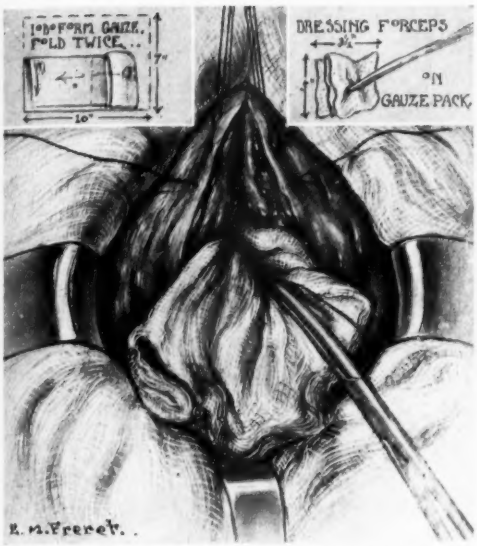


Fig. 5. Iodoform gauze is packed into the contracting uterus.

Fig. 6. First row of sutures tied. Second row of sutures in place.

the uterus with the bladder carried up to about the middle of the wound (Fig. 1). The wound edges are now protected with wet gauze towels and retracted with retractors—a traction suture passed through the uterus and grasped with forceps holds the uterus taut against the anterior abdominal wall (Fig. 2). The bladder reflection of peritoneum is now sought near one round ligament and picked up with tissue forceps, incised with a pair of curved Mayo scissors which are passed beneath the uterovesical fold and spread to separate it—this allows the superficial layer of peritoneum to be cut across (Fig. 2), care being taken not to get into the deeper tissues and so traumatize the superficial veins. The bladder is then detached by blunt dissection as in hysterectomy, and retracted with a Deaver retractor. With traction on the "traction suture" above, and retraction with the Deaver retractor below, the uterus may be readily incised with little or no bleeding unless the placenta happens to be under the uterine incision (Fig. 3). Care must be taken to make the uterine incision of sufficient length to permit of the easy expulsion of the head by pressure from above upon the uterus through the abdominal walls—or with the "Zelheim lifter" which slides it out by a shoe horn action.

It is best when possible to deliver the child by the head, for podalic version and extraction are apt to extend the incision in the uterus and cause irregular tears of the uterine muscle. When the child is delivered, the cord is clamped in two places by an assistant and cut between clamps.

The traction suture at the upper angle of the wound holds the uterus against the abdominal wall and prevents any eventration of the intestines. The uterine wound is now sutured, the suture beginning at the upper angle. No. 2 chromic catgut is used on a Hagerdorn needle. Each suture in the upper third of the wound passes through the serosa, the entire thickness of the uterine muscle on the one side, just skipping the endometrium, and through the muscularis and serosa on the opposite side. Of course, in the lower two-thirds only the muscle is included in the stitch. These sutures are placed at half inch intervals. Their ends are clamped and held.

The time consumed in placing the sutures allows the uterus to contract and retract and separate the placenta (Fig. 4). In clean cases, we have found it best to allow the placenta to separate spontaneously, and then after its removal to pack the cavity of the uterus with washed iodoform gauze (Fig. 5), leaving the gauze *in situ* to be delivered through the cervix by uterine contraction. After the placenta is delivered and the gauze inserted, the sutures already *in situ* are tied and closure of the uterus is completed by placing superficial sutures

Fig. 7. Bladder peritoneum sutured over uterine wound. Downward pull of anterior face of uterus by traction on sutures.

Fig. 8. Uterine wound completely covered and in apposition with bladder. The return suture has been nearly completed.

through the muscularis and serosa and through the muscularis alone between each of the deeper sutures. In the upper third of the wound this causes a slight infolding of the edges of the serosa (Fig. 6). When the uterine wound is closed and the ends of the sutures cut short, the wound is covered with the bladder reflection. This is done with a continuous suture which is begun at one round ligament and is finished at the opposite round ligament, the peritoneal flap being carried across the front of the uterus covering the uterine wound (Fig. 7).

It has been our custom to add to the safety of this exclusion by making a second line of sutures which infolds the first, and effectually seals the uterine wound from the possibility of peritoneal leakage. It is immaterial when there is sufficient bladder flap whether we make the upper peritoneal flap as suggested by Beck or not.

In potentially infected cases, in which the membranes have been ruptured for a long time and the cervix is fully dilated, the placenta, after it has separated, may be expressed through the cervix into the vagina as in the normal case, by simply making traction on the untied sutures which have been placed in the uterine wound, thus closing it at the same time that the Créde maneuver is used. The uterus is then packed through the uterine wound as already described, and the sutures tied and cut. The subsequent exclusion of the wound is carried on, as in the relatively clean case.

Remember that we do not claim that the transperitoneal section can replace the Porro operation in infected cases, rather that it has advantages over the classical operation and should be more generally used. If this operation is properly done, the finished result is shown in Figure 8. The uterine wound is completely excluded, no intestines have been seen, and no areas soiled from the uterine spill.

The abdominal wound is then closed in the usual manner, peritoneum to peritoneum, fascia to fascia, muscle to muscle, while the anterior fascia is closed with a chain stitch of chromic catgut. The skin is closed with clips or a running silk suture. The wound dressing consists of a layer of perforated oil silk and two thicknesses of 4 by 8 gauze.

AFTER-TREATMENT

The after-treatment of these patients should be as follows: After the woman has reacted she is placed in a moderate Fowler position, with a Harris drip. She is given a course of ergot and pituitrin: one ampule of pituitrin immediately upon closing the uterine wound, and 15 minims of ergotol every hour for 6 hours after her return

from the operating room. The other treatment consists of routine morphia in 1/12 grain doses every 4 hours for the first 24 hours; water on the cessation of vomiting; and a soft diet after the first 36 hours.

POINTS TO BE EMPHASIZED

The points that are important in this technique and need to be emphasized are: first, the low abdominal incision. Second, the placing of the traction suture in the uterus at the upper limit of the abdominal incision which, when held taut, makes a perfect occlusion of the wound. Third, the separation of the peritoneal flap, including the bladder. Fourth, the delivery of the fetus by the head. Fifth, the allowing of the placenta to separate spontaneously. Sixth, the packing of the uterus with washed iodoform gauze to stimulate its contraction and retraction. This gauze is usually found in the vagina at the end of 24 hours. Seventh, the complete occlusion of the uterine wound by the suture of the bladder reflexion over it which prevents the possibility of peritoneal leakage and intestinal adhesions.

A RATIONAL MANAGEMENT OF SKIN GRAFTS[1]

By FERRIS SMITH, A.B., M.D., F.A.C.S., Grand Rapids, Michigan
From the Grand Rapids Clinic

IT IS interesting to note that one of the oldest useful procedures known to surgery could pass through 60 years of frequent application without any accurate or rational basis for its total technique. One has reason to believe that the art of skin grafting is among the earliest of surgical accomplishments, as it was used by the Kooiman priests for rhinoplasty two thousand years ago. Between that time and the work of Riverdin in 1869, little, if any, and certainly no scientific attention, was paid to the subject. It remained for Riverdin to re-demonstrate the parasitic quality of skin and to point out its value to surgery. He enunciated certain rules for procedure both in the procuring and the application of the skin, but he did not stimulate any interest in "why" it grew, nor "how" it grew, nor did he take the next step to determine why larger pieces of skin did not grow in a similar manner.

Stimulation in this work resulted in very valuable contributions by Ollier, of Lyons, and J. R. Wolfe, of Glasgow, in 1872. To Thiersch, of Leipzig, belongs the credit of perfecting and popularizing the work of Ollier and to Fedor Krause the credit for important modifications of the method of Wolfe. Meanwhile there have been innumerable experiments, some fantastic and many of them sound, with skin from various sources, used under various conditions. The majority of workers agree upon the certainty and widespread application of the Thiersch method, but the number of opinions as to the essentials of success with the full thickness graft of Wolfe is limited only by the number of operators. It is this lack of any scientific basis for procedure that has produced such varying reports of success and convinced some operators that only small grafts of this type should be attempted. Successful Wolfe grafting is essential to the facial surgeon and extremely important in plastic procedures on other parts of the body.

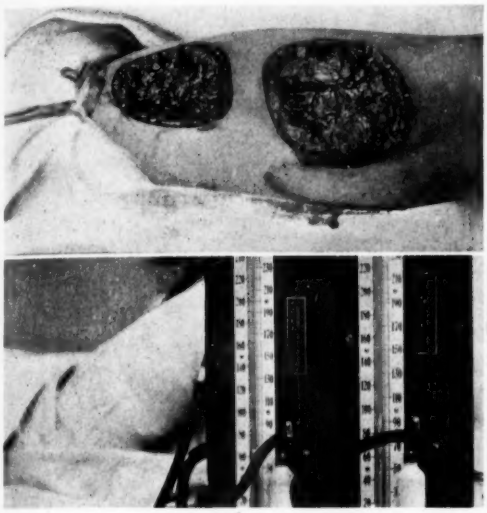
Only two types of auto- and iso-grafts, the full thickness graft of Wolfe-Krause, and the split skin of Ollier-Thiersch, merit our attention; the third type, the zoograft, being too spectacular and too unnecessary to deserve serious consideration.

There is a wide difference of opinion as to the *source of the grafts*. It is universally conceded that the autograft is the type of choice, but it is held by some authors that none other will succeed. McWilliams states in a recent article that he has never had any success with isografts and believes that the reports of success with this type of grafts may be relegated to mythology. On the contrary, Davis reports 40 cases with 19 successes, 16 partial successes and only 5 failures. In our experience, we have a number of patients who possess isografts varying in age from 1 to 9 years. The most striking of these is a child who suffered a congenital absence of the lower lid. The lining of her plastic lid was made from a hinged infra-orbital flap and the covering from a full thickness graft taken from the inner surface of the thigh of a nurse who possessed the same blood type. This graft is exceptionally good after a period of 2 years. Shawan concluded from observation and experiment that "skin grafting obeys the principle of blood grouping, as in the transfusion of blood." It is not only reasonable, but highly probable that isografts taken from donors with compatible blood types frequently grow as well as autografts, and equally certain that such grafts from donors with incompatible blood *may* grow, but will not persist.

The best sources of skin are the upper arm in the male and the thigh in the female, the inner aspect of either being chosen when soft, hairless skin is required. There is no especial advantage in choosing skin from an area of tension, such as the deltoid, nor in taking skin from the prepuce, scrotum, etc. The only exception is the choice of skin from the ear or another eyelid for grafting about the eye. Nor is there any virtue in producing artificial hyperæmia before cutting the skin or obtaining split skin for Thiersch grafting from a bloodless area. It is within the observation of all of us that epithelial scrapings, "dust," and dried particles of skin will grow, but that the ease and certainty of growth will not compare with tissue obtained in the usual manner. This brings us to a consideration of the essentials of growth in grafts. All of the conditions are essential to the full thickness variety while one or two only are vital to the split graft.

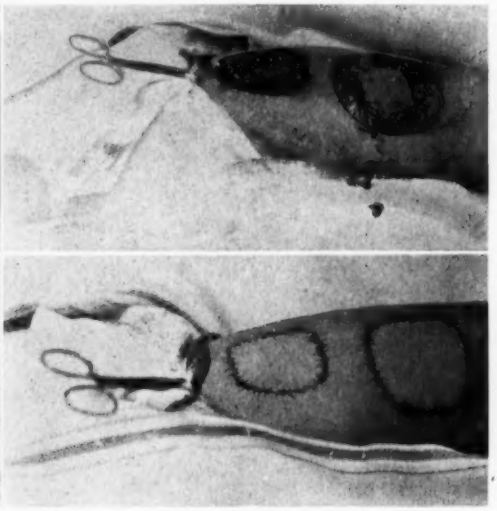
It is obvious that a graft is parasitic and must exist upon the absorption of "tissue juices" or lymph during its first 2 or 3 days of existence. Hence, its intercellular spaces must be open to the circulation of lymph in order that nourish-

[1] Read before The American Society of Oral and Plastic Surgeons, Philadelphia, October 27, 1925.



1 A.
2 A.

Fig. 1 A. The graft must be cut accurately to size.
Fig. 1 B. Contracted skin removed from area shown in A. Note the relative size.



1 B.
2 B.

Fig. 2 A. Grafts applied at pressures of 60 and 100 millimeters.
Fig. 2 B. Same skin approximated under normal tension.

ment may be carried to its cellular elements. Whole blood cannot accomplish this requirement and its collection beneath a graft causes it to perish. These considerations make it obvious that the commonly accepted advice to allow for contraction and to cut the graft one-third to one-half larger than the area to be covered is one of the commonest sources of failure. The graft *must be cut accurately to size and maintained at normal tension* (Figs. 1 and 5).

For the same reason, it *must be accurately approximated by carefully placed sutures* (Fig. 2). The entrance of lymph from its circumference and the early ingrowth of vessels around this border are big factors in successful nourishment. Occasionally, one sees a graft which lives for three-quarters of an inch around its border and dies in the center, as the result of faulty dressing.

The skin *must be free from fat.* Gillies says that "the question of whether a graft shall be skin deep or contain a layer of fat is determined by the needs of the case, there being no marked disparity between the two in the matter of viability." This same claim was maintained by Hirschberg in 1893 and more recently by F. Krause and others. It is true that skin with its fat *occasionally* grows under very favorable circumstances, but consideration of the source of its nourishment and an overwhelming experience to the contrary by many operators, classifies this as an exception, rather than a rule.

The graft *must be accurately approximated to its base by a proper, even pressure.* The necessity for this approximation and pressure has been obvious to all of us but the means of accomplishing the approximation and the question of a "proper" pressure has given rise to endless opinion and controversy. Numerous dressings have been advocated to meet this requirement, the most recent to win favor being the synthetic rubber sponge. The elasticity and compressibility of this product permits accurate approximation of all parts of the flap, but it possesses none of the other virtues ascribed to it.

Various authors describe the proper pressure as "gentle," "moderate," "firm," "very firm," and "a bandage so tight that it hurts." One may take a choice and guess at the dressing pressure which yields the most success, because none of these terms convey the same impression to two individuals.

We have determined by experiment that the ordinary bandage used to fix dressings exerts a pressure upon the soft parts equal to 5 to 10 millimeters of mercury; that a "firm bandage" exerts a pressure of approximately 30 millimeters of mercury; that a "very firm" bandage, one that is painful when applied to the thigh and

Fig. 3. Dressed at pressure of 100 and 60 millimeters of mercury.

Fig. 4. Dressed at pressure of 110 and 70 millimeters of mercury.

cuts off the venous return from the leg, exerts a pressure of 45 to 55 millimeters of mercury; and that a dressing applied over a bony base, the forehead, with all possible tension from a gauze bandage, exerts a pressure of 85 to 100 millimeters of mercury.

We have dressed Wolfe grafts, prepared and approximated as described, with maintained pressures varying from 30 to 110 millimeters of mercury and determined that the higher pressures are disastrous to the flap. Grafts on one patient were applied with pressures equaling 60 and 100 millimeters of mercury (Fig. 2). Some areas of the 60 millimeters graft lived after a long questionable period, and the greater portion of the 100 millimeters graft softened and came away (Fig. 3). Grafts on another patient were applied at pressures of 70 and 110 millimeters of mercury. They promptly became gangrenous and were removed (Fig. 4). For this purpose, flat, moderately thick-walled balloons were constructed to produce accurate approximation and maintain the pressure desired. It was observed that stretching of the gauze bandage holding the dressing in position allowed the pressure to fall during the first 2 days and required frequent correction, until the stretching ceased. The use of lint bandages and adhesive reinforcement corrects this condition.

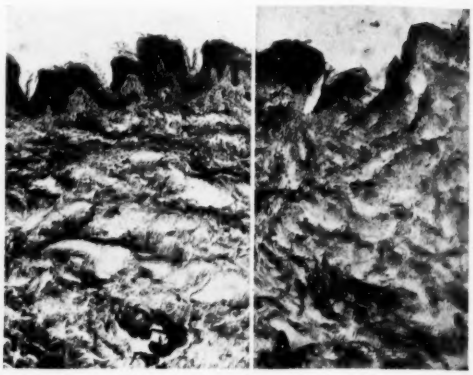


Fig. 5. At left, skin under normal tension, and contracted skin.

The "proper" pressure must be that pressure which insures maximum nourishment, lymph, to the part and the graft and prevents fluid collection, with consequent flap separation.

Ludwig and his pupils advocated and maintained the importance of the mechanical factor of filtration of blood plasma through the capillary walls as a source of lymph. Starling determined that "the quantity of lymph is usually proportional to the height of the capillary pressure." This being true, any factor which will raise the capillary pressure will favor the increased flow of lymph. Further, we know that the peripheral venous pressure varies from 5 to 15 millimeters of mercury and that the arteriole pressure ranges from 40 to 50 millimeters of mercury. A pressure, then, which will compress the venules, that is, more than 15 millimeters of mercury, and will partially compress the arterioles, meets our requirement. A dressing at a pressure of 30 millimeters of mercury has been very satisfactory in our experience.

This same care is not vital to the success of split skin grafts. Any inert material will serve to approximate this graft. A simple technique consists in smearing the source of the graft with a thin layer of vaseline, which materially facilitates the cutting of the piece, and arranging the pieces, raw surface outward, on dental impression compound which has been molded to the part to be covered. This is applied with a firm bandage without measuring the pressure. The author does not believe that the various types of wet dressings, powders, etc. are essential to the success of grafts.

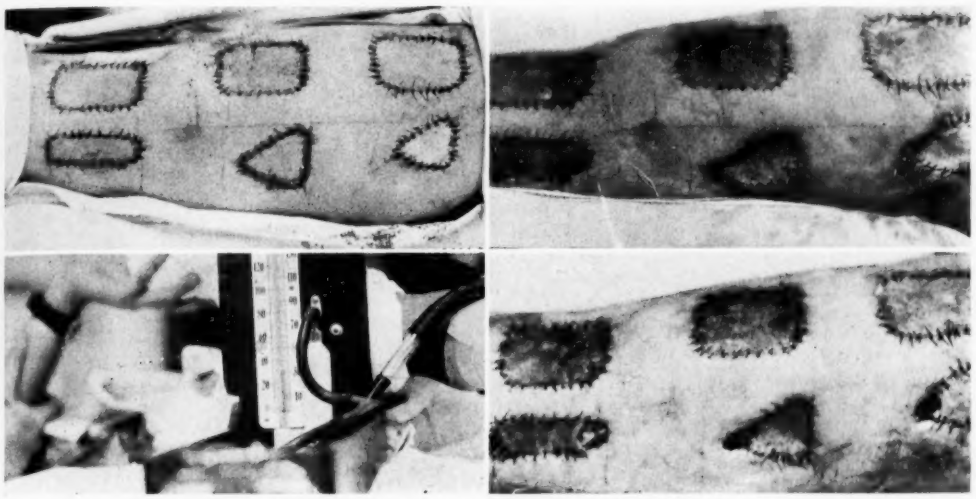


Fig. 6. Autograft and control; compatible isograft, same blood type; non-compatible isograft, all dressed at pressure of 30 millimeters mercury. Above, right, second day; below right, fifth day.

Finally, the *grafted part should be immobilized* for several days. During the first 24 hours the graft is glued to its base by coagulated lymph which must not be disturbed.

The following general observations apply to autografts and compatible isografts during their early days of existence.

The presence of a parasitic foreign body, the graft, induces the reaction of inflammation with a resulting invasion of the corium by large numbers of polynuclear leucocytes.

The epithelium plays no part in the reconstruction and growth until new blood and lymph supplies are established. It frequently degenerates because of faulty nutrition during the period of parasitic lymph absorption before the establishment of a new blood supply.

The papillary area of the corium exhibits marked degenerative changes during the first few days. Some areas perish and substitution occurs from both the tissue of the host and the connective tissue of the graft.

Between the second and the fifth days, there is a considerable proliferation of connective tissue cells and vascular endothelium which continues until the time of complete regeneration.

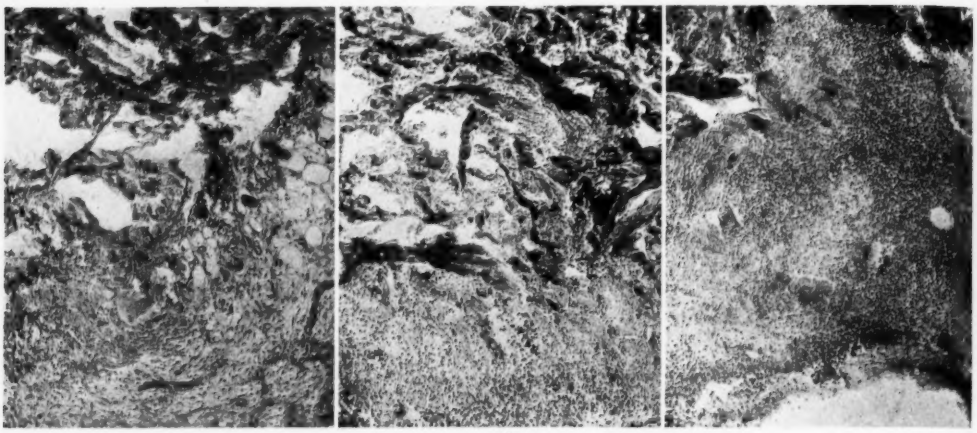
The elastic fibers degenerate late and are regenerated from surrounding elastic tissue.

The following histological observations are furnished by Dr. W. M. German.

Histology of contracted skin and skin on normal tension. A. Contracted skin. Epidermis and corium are normal in cellular structure. There is a contraction of the corium in all planes, throwing the epidermis into numerous folds and causing much irregularity of the bundles of the intercellular substance. The blood vessels are contracted and empty and the spaces between the cells and connective tissue bundles are small.

B. Skin on normal tension. Epidermis and corium are normal in cellular structure. The connective tissue bundles of corium show a distinct tendency to be parallel to the plane of the skin surface. The vessels are contracted and not all of them are empty. The epidermis is not drawn into convolutions, but shows a tendency to occupy a single plane. The spaces between cells and

Fig. 7. Tenth day.



a. *b.* *c.*

Fig. 8. Tenth day. *a*, autograft; *b*, compatible isograft; *c*, non-compatible isograft.

bundles of intercellular substance are distinctly larger than in the case of the contracted specimen (Fig. 5).

SPECIMENS REMOVED THE SECOND DAY
FIGURE 6

Autograft. There is a beginning maceration of the stratum corneum, diminished staining reaction in the stratum granulosum and an increase in pigmentation in the basal layer. The papillary layer of corium shows œdema. The deeper layers are in good condition. The elastic fibers show no changes. Beneath the graft there is an exudation rich in polynuclear cells and wandering cells showing a tendency to infiltrate the graft between the connective tissue bundles. The blood vessels are contracted and empty.

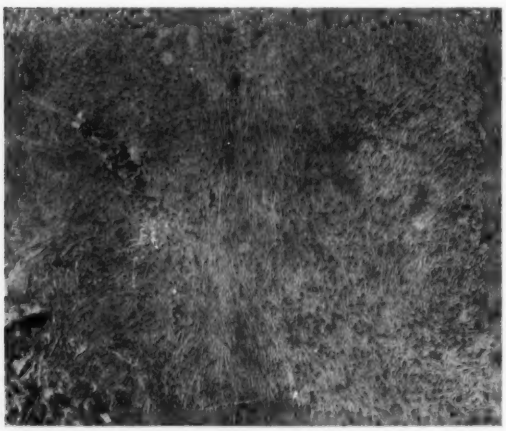


Fig. 9. Autograft, twentieth day, showing organization in the lower layers and at point of attachment.

Isograft from a donor with compatible blood. The epidermis is well preserved, though there is a tendency to maceration of the stratum corneum. The basal layers of epidermis show diminished staining reaction. There is a moderate œdema of the superficial layers of corium with autolytic changes in the sweat glands. Beneath the graft there is an exudation rich in polynuclear cells attempting to infiltrate between the connective tissue bundles of the corium.

Isograft from a donor with incompatible blood. There is an accumulation of fluid between the stratum lucidum and stratum granulosum and with maceration of superficial layers. The basal layer shows diminished staining reaction. The corium shows distinct tendency to autolytic changes. Connective tissue shows a pyknosis and autolysis of cells with œdema of connective tissue bundles, particularly in upper layers. The sweat glands and the blood vessels show distinct degenerative changes. At the base of the graft there is an exudation rich in polynuclear cells with scanty fibrin and a distinct tendency to polynuclear infiltration of graft. The elastic tissue bundles show no important changes.

SPECIMENS REMOVED ON THE FIFTH DAY
FIGURE 6

Autograft. There is maceration of epidermis extending down to stratum lucidum. The basal

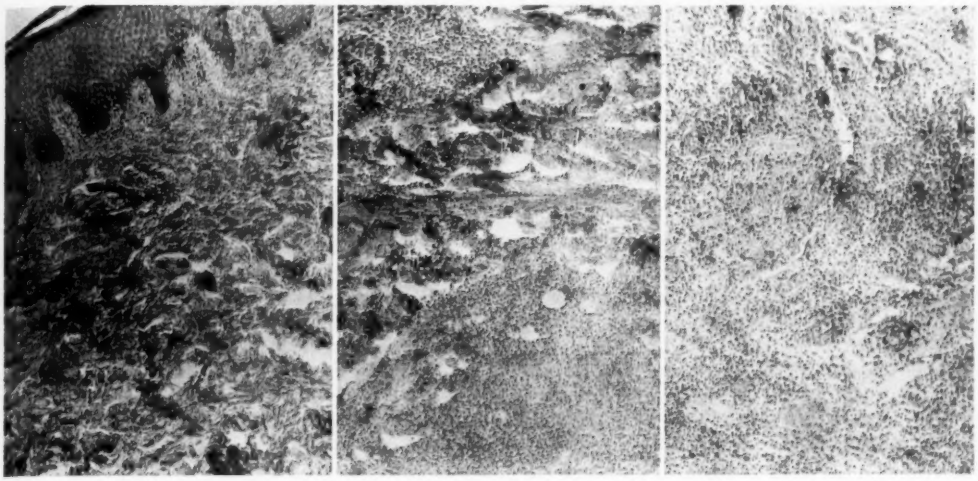


Fig. 10. Autograft, compatible isograft, and non-compatible isograft, twentieth day.

layers are in good condition. There is œdema of the papillary layer of the corium, but the deeper layers are in fairly good condition. At the base of the graft there is an exudate containing polynuclear cells, proliferating fibroblasts and endothelial cells with endothelial sprouts showing invasion of the graft. The elastic fibers are in good condition.

Isograft from a donor with compatible blood. The epidermis has desquamated in places, particularly in the superficial layers, though basal layers seem to be in good condition. There is œdema of the superficial layers of corium with beginning disappearance of connective tissue cells leaving œdematous intercellular substance. Beneath the graft there is a beginning attempt in organization with production of endothelial buds.

Isograft from a donor with incompatible blood. There is marked maceration and desquamation of epidermis, an accumulation of fluid in the deeper layers and a loss of staining power of the basal cell layer. There is marked degeneration of corium with œdema of all structures, invasion with polynuclear cells and marked lytic changes in sweat glands. At the bottom of the graft there is an exudation rich in polynuclear cells, but showing only scanty evidence of organization changes.

SPECIMENS REMOVED ON THE TENTH DAY
(FIGURES 7 AND 8)

Autograft. The epidermis is in good condition. It shows some early growth activity in the basal layers. There is some œdema of the papillary process of the corium, though for the most part the corium is in good condition. Beneath the corium there is an intense proliferation of young fibroblasts and endothelial cells with endothelial buds which are growing upwards between the connective tissue bundles. The elastic fibers show little change.

Isograft from a donor with compatible blood. In some areas the epidermis has completely desquamated. In remaining portions the basal cell layers are in good condition and show early growth activity. There is marked degeneration of superficial layers of corium; the cells are practically absent, leaving only œdematous intercellular substance. The sweat glands show marked autolytic changes. Beneath the corium there is an exudation rich in polynuclear cells which is infiltrating the spaces between the connective tissue bundles and in some areas a distinct proliferation of young fibroblasts and endothelial buds though less marked than in autograft of the same age.

Isograft from a donor with non-compatible blood. Sections show complete loss of epidermis, marked degenerative changes throughout the corium leaving only intercellular substance. There is an intense exudation containing polynuclear cells with marked infiltration of the corium by polynuclear cells. There are a few feeble attempts at organization changes limited to the portions nearest the bed of graft. Some areas show necrosis and abscess formation.

SPECIMENS REMOVED ON THE TWENTIETH DAY
(FIGURES 9 AND 10)

Autograft. Section of upper layers of skin showing the epidermis is in excellent condition, with growth activity. The corium likewise is returning to normal.

Section through deeper layers showing the wide zone at the base of the graft of well organized repair tissue.

Isograft from a donor with compatible blood. Section through upper layers. Absence of epidermis and only a few remaining strands of former corium which is degenerating and surrounded by granulation tissue containing phagocytic cells.

Isograft from a donor with non-compatible blood. Section showing almost complete removal of former corium, one small island remaining in the center of field. Masses of granulation tissue infiltrate with phagocytic cells.

These essentials to the growth of full thickness grafts have been advocated by the author for a dozen years. The principal of "cutting to exact size" and "carefully approximating to maintain normal tension" was advanced by him and practiced by several operators with considerable success in The Queens Hospital in England during the War and has since been urged on numerous occasions. It is to be hoped that the substitution of sound scientific proof for former theory will stimulate a wider application of this very useful procedure.

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AN IMPROVED SYRINGE AND NEEDLE FOR USE IN REGIONAL ANÆSTHESIA[1]

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Section on Anæsthesia, Mayo Clinic

THE syringe and needle herein described are modifications of those used by Labat and Meeker. The needle, however, has undergone but one alteration.

The syringe is made with a glass barrel with a capacity of 10 cubic centimeters, and metal ends. The attachment for the needle is offset and equipped with a bayonet style lock. The piston is ground to fit the barrel, and has been made with a piston ring. Heretofore there has been difficulty with this piston, in that the solution would seep past it and accumulate on the wrong side of it. This difficulty has been minimized by increasing the length of the plunger. The barrel has not been lengthened purposely. When the syringe is filled with solution so that the lower border of the piston rests on the 10 cubic centimeter line, only a small space remains for the purpose of aspirating. This is desirable, as experience has taught me that gentle aspiration is preferable to a more vigorous one, which frequently plugs the end of the needle by attracting tissue instead of blood. On more than one occasion I have aspirated blood from the caudal canal on the third of three consecutive aspirations, although the first two produced no blood. This resulted directly from three degrees of aspiration, the first being very forceful, the second less so, while the third was gentle. I infer from such instances, that an overvigorous tug on the plunger draws solid tissue against the bevelled tip of the needle and prevents an upward flow of blood. This is undoubtedly true when the bevelled edge of the needle lies against the thin wall of a vein. Successful aspiration of blood has a definite significance. The absence of blood, on the other hand, may prompt a feeling of false security based on the belief that the needle is outside a blood vessel. As an additional precaution against misinterpretation, therefore, I very carefully and slowly inject three or four drops of the solution with the idea of freeing the tip of the needle from the tissue, before gently repeating the aspiration. This is first done without moving the needle, then it is repeated while the needle is rotated. If no blood is obtained under these circumstances, one can be reasonably sure that the injection will not be into a vein. Nevertheless, the solution going into the caudal canal should be injected very slowly, while the patient is closely watched for signs of the sudden reaction characteristic of an intravenous injection.

The handle or grip on this syringe consists of a finger ring on the end of the plunger. Small, flat, metal rests occupy the top and bottom of the ring and provide satisfactory pressure-bearing surfaces whether the thumb is in the ring, or the ring pressed against the palm. Two finger rings split laterally have been placed on either side of the metal cap, which screws onto the end of the barrel. The split ring permits the gloved finger to be withdrawn both laterally and longitudinally, so that the hand is easily disengaged. The use of rubber gloves while the injection is being made prompted the introduction of this new grip. The side rings, together with the thumb ring, permit

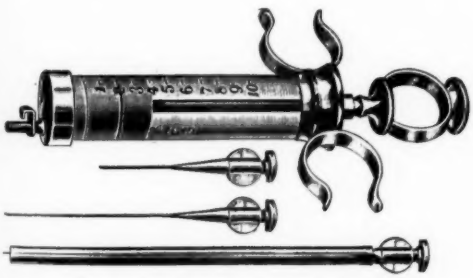

Fig. 1. Drawing of syringe and needles.

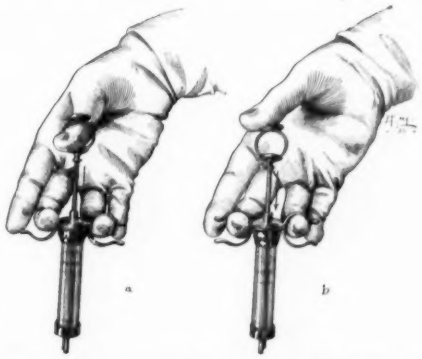

Fig. 2. a, Injecting with thumb through ring of plunger and fingers in rings. b, Injecting with thumb above ring of plunger and fingers in rings.

[1]Submitted for publication, July 20, 1925.

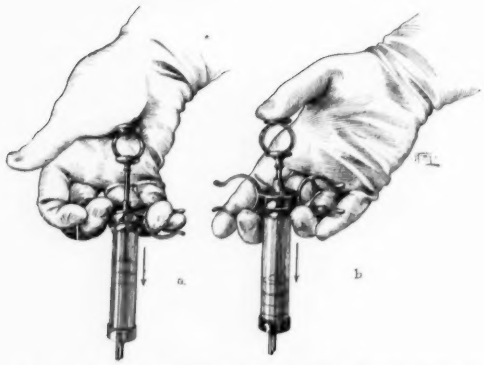

Fig. 3. a, Injecting with ball of thumb and ring of plunger and fingers through rings. b, Injecting with thumb on plate over ring of plunger and fingers beneath rings.

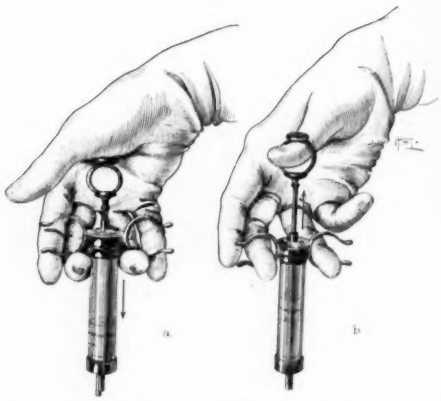

Fig. 4. a, Ball of thumb over ring of plunger for injecting and other fingers beneath rings. b, Filling syringe by pulling upward on plunger with thumb in ring of plunger and other fingers in rings.

five different grips, the most comfortable one depending on the size of one's hand, the amount of solution in the syringe, and the amount of pressure desired (Figs. 1, 2, 3, and 4). The effect is to produce the desired pressure at all times, and, although high pressure may result disastrously to the syringe, nevertheless there are times when it must be produced. A field block in the scalp, for instance, often requires that the solution be injected with more than the average pressure. This grip, or handle, has slightly increased the bulk and weight of the syringe, but when the barrel is full of solution, the instrument has a very satisfactory balance. For those who inject many patients in succession, this grip affords a certain amount of rest for the hand, inasmuch as the four fingers are divided and two may be placed in each split ring instead of one. The preferable grip on a syringe is with the thumb, middle, and ring fingers, whether two fingers are in a ring or not. Aspiration and refilling are accomplished with one hand (Fig. 4b), if the piston has been carefully ground to fit the barrel; otherwise it would stick and require the use of both hands to fill the syringe.

The needle has been especially prepared for the injection of the abdominal wall. The shoulder of the needle has been tapered to join with the shaft, giving it the appearance of an awl (Fig. 1). It is possible to dilate the skin perforation so that injection may be made without any drag on the shaft of the needle. By eliminating the friction of the skin against the shaft of the needle, the jerk of the needle as it punctures the fascia has been exaggerated. For the novice, this is a safeguard in the ordinary abdominal injection; for the experienced operator it is a safeguard when fascial layers are so thin that with the ordinary needle there is no jerk when they are punctured.

The needle, after being firmly attached to the syringe, is passed through a wheal, already raised. It is then thrust parallel to, and immediately below the surface of, the skin until the entire shaft is buried. The tapered shoulder is then forced in after the shaft until the hole in the skin has been dilated sufficiently to permit an entirely free motion of the shaft through it. If the shaft should break, it would still be subcutaneous and parallel to the surface and therefore easily removed by forcing it on through the skin and upward to the outside by pressing downward and forward against the broken end of the shaft, at the same time, with the forefinger of the other hand, pressing the skin down and against the sharp point of the needle. After part of the solution has been injected subcutaneously, the needle is withdrawn until the point lies just under the original wheal; it is then advanced downward, and the fascia is searched for. When found, this is perforated, and about 2 cubic centimeters of solution injected there. The various necessary fascial punctures are thus accomplished with a feeling of satisfaction that the peritoneal cavity has not been pierced. Patients with such thin or delicate fascia that they cannot easily be felt constitute a considerable number of the cases to be injected, and are obviously of considerable concern. It is common knowledge that the needle occasionally enters the

abdominal cavity and, even though damage is seldom done, it is to be avoided if possible. The tapered shoulder lends strength to the needle and for that reason it is used on needles of different sizes from those ordinarily employed in abdominal block.

The syringe and needles are easily sterilized by boiling. The syringe may be kept in alcohol between cases when frequently used. Needles are freshly sterilized in boiling water. Information as to the care of syringe and needle may be found elsewhere.[1, 2]

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PRURITUS ANI; TREATMENT BY ALCOHOL INJECTION

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THE purpose of this paper is to call renewed attention to a method of treatment for pruritus ani already published, and to report further experience in its use[1]. There is no need for an elaborate general discussion of pruritus ani. Some cases of itching about the anus are no doubt due to various local causes, such as small fistulæ, irritated skin tags, and pinworms, and a few may be reflex manifestations of some visceral lesion, as Montague has urged, or due to some general condition like diabetes. A fairly wide experience, however, leads to the firm opinion that true pruritus ani of the "idiopathic" type is a genuine clinical entity of characteristic appearance, the cause of which is entirely obscure at present. The intensity of the itching varies from a minor annoyance to a serious disturbance of health, with loss of sleep and distressing nervous irritability.

There is no satisfactory treatment. The method herewith presented is not satisfactory for one reason: it is not as a rule permanent in its results. In this regard it is not different from other procedures. Otherwise it is by far the best treatment with which the writer is familiar and has afforded most welcome relief to many patients. The details of execution of the injections will be described, and then a brief statement of its rationale and of our results will be presented.

The patient is placed in the lithotomy position under light general anæsthesia: ethylene gas is particularly suitable, but nitrous oxide or light either may be employed. Formerly local anæsthesia was given in a number of cases, but general narcosis is better. The infiltration of the tissues with local anæsthesia dilutes the alcohol and is otherwise confusing by distending the area injected. The field is prepared as for any operation, and by the "field" is meant the whole of the area involved. At times this may extend backward over the sacrum, forward about the genitalia and groins, and laterally toward the buttocks. The patient can describe the extent of the involvement before operation, but as a rule the inflamed and indurated appearance of the skin itself indicates the region to be injected. The material used is pure 95 per cent grain alcohol without denaturizing substances. This is injected with the ordinary small hypodermic syringes, with fine needles not over an inch long. Larger syringes and coarser needles may lead to placing too much alcohol in one spot or putting it in under too great pressure. The needles are plunged vertically entirely through the skin, and the alcohol injected into the subcutaneous tissues. Only 2 to 4 drops are injected at each puncture. The punctures are spaced about ¼ inch apart and are "stippled" over the entire area involved. The injections are carried up to about ¼ inch from the anal margin, but are not made within the anal canal itself. The scrotum, labia majora, and folds of the groins have been injected without resulting trouble. Blood vessels of course are to be avoided when possible.

After completing the injection, the area is sponged off with a wet alcohol sponge. No dressing is used. There is little after soreness, and if the injection has been properly performed, the itching is abolished at once. When the method was first being developed, there was some concern about possible sphincter paralysis, and sloughing of the skin. In no case has there been

[1] Stone, H. B. A treatment for pruritus ani. Johns Hopkins Hosp. Bull., 1916, xxvii, No. 306.

any muscle disturbance, and with the technique here described, no sloughs of any moment whatever have developed. Among the first cases there were several sloughs, due to the placing of too large a volume of alcohol through single puncture wounds, and also to injecting by mistake into the skin instead of under it. After an injection, there is a noticeable numbness of the perianal skin, but no disturbance of the sensory features of the act of defecation. There is a remarkable return of the skin to normal appearance within a few days after injection.

The principle upon which this treatment is based is the well known destructive effect of alcohol on nervous structures. It is analogous to the alcohol injections for trigeminal neuralgia. In the latter case there are a few definite nerve trunks to be reached. In the case of pruritus, the objective is the network of fine terminal sensory filaments that supply a varying area of skin. Hence the difference in technique. An alcohol injection does essentially the same thing as the surgical division of these cutaneous nerves, as aimed at in the Ball and Lynch under-cutting operations, and does it in a better and less objectionable way.

In the first publication on this subject, reference was made to the experimental development of the method on animals, by which the technique was worked out.

This treatment has been in use now for over ten years in the Rectal Clinic of the Johns Hopkins Hospital. During this time something over two hundred injections have been performed by Drs. A. H. Hebb, William Noble, and myself. Numerous other surgeons of my acquaintance have employed it occasionally. As a result of this experience the following conclusions may be drawn.

CONCLUSIONS

An injection properly performed by the technique herewith described gives prompt and complete relief. There are no serious complications or disadvantages to fear. With care, sloughing may either be avoided entirely, or reduced to a negligible degree. There is no prolonged hospital stay, no repeated treatments nor disagreeable applications to be made. The freedom from itching lasts for a variable and unpredictable time. A few cases are apparently cured, yet in 1 such case a recurrence developed after 6 years of complete freedom, and was then re-injected. A number of patients have had relief for several years. Some develop itching again within 3 months. The greater number seem to be clear for from 6 to 12 months, and then again are annoyed by the itching. Rarely is this as intense as at the time of the first treatment. There is no objection to repeating the injections as often as may be necessary. One patient, a physician, had his first treatment about 9 years ago, and has had two others in the intervening time, several years apart. It is freely admitted that this tendency to recurrence constitutes the great defect in the method. On the other hand, it is eloquent evidence on its behalf, that a number of patients who have tried almost every other form of treatment, having received one alcohol injection, return when necessary for a second or a third injection, in spite of recurrence, and with a wide experience of the possible alternatives.

THE TREATMENT OF THE ACUTE POSTOPERATIVE TOXÆMIA OF HYPERTHYROIDISM

By JOHN ROGERS, M.D., F.A.C.S., New York City

THERE are few more dangerous conditions than the acute postoperative toxæmia of hyperthyroidism. In my experience, it has occurred most commonly in those patients who present symptoms of marked exophthalmos, especially if they have previously had a pallid skin, or one which has become pigmented or bronzed; or a perceptible muscular atrophy in the hands and forearms. It is also more to be expected in those with firm rather than soft thyroid glands. In postmortem examinations of the gland only a dense mass of cells has been found with little or none of the colloid material which is supposed to represent the secretion. In other words, the patient dies, apparently, not from too much but from too little thyroid secretion, or an entire absence of it.[1] For this reason I[1] have for several years advocated, in the treatment of the acute postoperative toxæmias, the subcutaneous administration of a boiled aqueous extract of the thyroid. It seems to act by stimulation of the terminal filaments of the vagus or parasympathetic portion of the involuntary nervous system, and so does not increase the already alarming rapidity of the heart action.[2] This extract is now commonly available in a form known as the "thyroid residue." The detailed histories are given of 3 cases, recent experiences in rather close succession, of these serious postoperative toxæmias in which the patients seemed to be saved from death by the free administration of the thyroid residue.

Case 1. Miss M. G., age 18, was first seen in December 1924. She apparently showed the beginning of rather typical symptoms of mild exophthalmic goiter. She had worked very hard the preceding winter at school. The general nutrition was good; when she was quiet in bed the skin was pallid but flushed at the least excitement; there was distinct exophthalmos and a small, rather soft, "goiter"; the pulse rate averaged 112; the systolic blood pressure was 140 and the weight 123 pounds.

On January 19, 1925, under local anæsthesia, both inferior, and then 1 week later, both superior vessels were tied. There was comparatively little reaction and much improvement which seemed to be promoted by the administration of a 1 grain iodide of iron pill daily, with a glycerin ovarian extract.

In February, with a normal pulse rate and a gain of 5 pounds in weight, she went home where she was forced to take up a somewhat strenuous life. The hyperthyroid symptoms then began to reappear, and in the latter part of April, 1925, she returned to the hospital. The general nutrition was good, but there was a marked and somewhat dusky pallor, with distinct muscular atrophy in the hands and forearms. The exophthalmos was more pronounced than in December, the pulse rate averaged about 130; the systolic blood pressure was 150 and the weight was 120 pounds; the "goiter" was no larger but had become dense in consistency. With rest in bed, and a continuation of the iodine and ovarian feeding for about 3 weeks, the pulse rate decreased to an average of 115, but the gland remained very dense.

May 19, 1925, under gas-ether anæsthesia, the isthmus of the thyroid was excised and both lobes resected so that they were reduced to an approximately normal size. The cut surfaces of the organ resembled liver tissue. At the end of the operation the pulse rate was 160. Four hours later it had risen to 180, but there was none of the extreme restlessness which, in my experience, indicates an impending fatality.

The following morning the pulse had risen to 190 and the temperature to 103, and there was nausea and more restlessness. The condition appeared very serious. 15 minims of the thyroid residue were then given every two hours by mouth rather than hypodermically, as the patient vigorously resented the use of the needle. An almost immediate improvement followed. The nausea and restlessness decreased, and within the next 48 hours the pulse rate dropped from 190 to 150, and the temperature from 103 to 101. As the danger seemed passed, the thyroid feeding was then stopped, and on the fourth day after operation the pulse rate had fallen to 110 and the temperature was normal.

The patient left the hospital at the end of the third week after operation with a pulse rate which averaged between 90 and 100.

In this patient there was so much fear of the hypodermic syringe that it seemed unwise to force it; but the mouth administration of the thyroid extract seemed beneficial, and was certainly not followed by any increase of nervous irritability nor acceleration of the pulse rate. Of course, recovery might have taken place without it. Nevertheless, recovery, with a rapidly rising pulse rate and temperature before the administration of this remedy, seemed doubtful.

Case 2. Miss M. R., age 24, was first seen in September, 1924. She had always been "delicate," and her present symptoms of typical exophthalmic goiter apparently followed an attack of pyelitis a year or more ago. In September, 1924, she had been in bed for 3 months under small doses of iodine. The metabolism was +50; there was a moderate exophthalmos; a rather dense and small goiter; the pulse rate averaged 115; systolic blood pressure 130; weight 84 pounds.

In November, 1924, under local anæsthesia, both inferior thyroid arteries were ligated, and a week later both superior. A 1 grain iodide of iron pill was then given once daily and glycerin ovarian extract every 4 hours. Marked

[1] Am. J. M. Sc., 1923. clxv, 77.

[2] Am. J. Physiol., 1915, xxxvi, 103.

improvement followed, and in March, 1925, the pulse rate averaged about 90 and there had been a gain in weight of 10 pounds. She resumed her work in a shop, but that apparently caused a relapse, and in May she returned with the former symptoms much increased. The previously pallid skin was somewhat pigmented; the exophthalmos was ponounced; the previously soft thyroid felt dense; the pulse rate averaged 130; the systolic blood pressure was 140; the weight was 87 pounds. There was some diarrhœa, little or no subcutaneous fat and distinct muscular atrophy in the hands and forearms. In short, she presented a bad operative risk.

After 2 weeks in bed with the former medication of iodine combined with a glycerin extract of adrenal, which seemed to check the rather frequent bowel movements, there was some improvement in the nervous irritability and the pulse rate averaged about 120.

On May 13, 1925, under gas-oxygen anæsthesia, the isthmus of the gland was excised and each lobe resected to approximately the normal size. In spite of the previous ligation of all four of the chief thyroid vessels, the hæmorrhage was quite troublesome, apparently coming from the thyroidea ima. The cut surfaces of the gland, as in the previous case, resembled liver tissue. At the close of the operation the pulse rate was 160 to 170, and during the afternoon ran to between 180 and 190, and the temperature had increased to 103. The restlessness was partly controlled by morphine.

On the following morning the pulse rate was difficult to count, but probably did not reach 200, and the restlessness had been succeeded by stupor. The temperature was 103.5 degrees F. Twenty minims of thyroid residue were then given every 2 hours hypodermically. In the afternoon consciousness was so fully restored that she objected vigorously to the hypodermic needle, and the pulse rate had begun to decrease. The next morning the pulse rate and general condition were so obviously improving that the hypodermic medication was suspended. In the evening of the third day after operation the pulse rate had decreased to 110, and a week later was practically normal.

I have seen other patients who developed similar symptoms referable to the central nervous system, but not another in stupor, who recovered either with or without the hypodermic administration of thyroid. In this particular instance it seemed to be life-saving.

Case 3. Miss A. S., age 16, was first seen in May, 1925. She gave a history of scarlet fever 2 years previously. Six months after recovery the goiter was noted. This gradually increased in size, and then exophthalmos appeared. There was a pronounced pallor when at rest, but the least excitement or exertion produced a flushed and moist skin; there was pronounced exophthalmos, more noticeable in the right than in the left eye. There was a large, firm goiter extending from the supraclavicular region well above the thyroid cartilage (higher on the right than the left side). There was a distinct "purr" in the easily palpable superior vessels. The pulse rate averaged 130; the systolic blood pressure was 120; the weight was 111 pounds; the metabolism was taken at only 35, but the other symptoms seemed to indicate a bad operative risk.

June 2, 1925, both inferior thyroid vessels were ligated under local anæsthesia. As a preliminary operation this is simpler and, subsequently, much less painful than the common ligation of the superior vessels.

On June 9 the pulse rate had decreased to an average of 100, and the temperature, which had varied between 100 and 101, was normal.

June 10, 1925, under gas-ether anæsthesia, after both superior vessels had been ligated, the right lobe was resected to nearly the normal size and the superfluous part of this lobe with the isthmus removed. While the left lobe was being resected, the pulse suddenly began to be very feeble and rapid, as could be noted by the bleeding vessels and by the anæsthetist. Its rate could not be accurately counted, but it was above 200. Thirty minims of the thyroid residue were then administered hypodermically into the left arm and the operation continued. But 5 minutes after the injection the heart-beat became evidently stronger, and after the wound was closed the pulse rate was counted at about 200. Thereafter for 24 hours 20 minims of the thyroid residue were given hypodermically at intervals of 2 hours. The temperature did not go above 103, and comparatively little of the usually threatening nervous irritability developed.

The pulse rate under this treatment steadily declined, and on the second day after operation was 120. For the next 2 days the thyroid residue was given every 4 hours and then stopped, as it seemed to produce no further benefit.

On June 20, the pulse rate was 100, respiration 20 and the temperature normal.

This patient, like the other two, seemed thus to be saved from a very dangerous condition. Without the thyroid residue given during the operation, I feel sure she would have died. In none of these cases was any ill effect noted.

This does not mean that the extract is harmless, because I have tested it in patients who were under the usual medical treatment for severe hyperthyroidism, and it evidently intensified the disturbance.

The medical "crises" of hyperthyroidism do not usually develop with such startling rapidity as do those which follow operation. Furthermore, the evidences of total absence of colloid are not so clear. The appearance of the cut surface of the gland during the operation and the necessary accompanying traumatism which should temporarily stop the functioning of this organ supply good reasons for the administration of an active thyroid extract. Because the more prolonged types of the disturbance are often intensified, or at least not manifestly benefited by this treatment, I have hesitated to employ it, and in the postoperative toxæmias I think I have hitherto generally waited until it was too late. After the central nervous system has become badly damaged, no treatment can prevent death. But when alarming symptoms appear during the operation or immediately afterward, I do not hesitate to administer the thyroid residue in 20 or 30 minim doses every 2 hours. I believe that, under these conditions, it is entirely harmless and can be more beneficial than any other treatment.

ECLAMPSIA: ETIOLOGY AND TREATMENT[1]

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"ECLAMPSIA is an acute toxæmia occurring in pregnant, parturient or puerperal women, and is accompanied by clonic and tonic convulsions, during which there is loss of consciousness followed by more or less complete coma, and frequently results in death." In this definition by Williams is told all that is actually known of the etiology of eclampsia.

Many theories have been evolved, the results of centuries of speculation by numberless workers in obstetrics; few have withstood the test of time and experience. With each new theory as to the cause of eclampsia there has been proposed a new plan of treatment. Many of these methods have been discarded permanently, others have been abandoned temporarily while one or two principles have, up to the present time, been universally recognized as correct.

Every theory which has been proposed as to the cause of "convulsive puerperal toxæmia" has some degree of plausibility, and until our knowledge shall be greater than it now is, no idea should be dismissed without careful consideration and absolute proof of its unworthiness. At the present time it seems true that the toxin of eclampsia originates in the product of conception, that it is eliminated principally by the bowels and kidneys, and that it results in profound toxæmia when the digestive tract is not functioning properly. When to the fetal toxins are added the results of sluggish bowel action and a high protein diet, the maternal organism is over-taxed. The most successful methods of treatment are those which combat the formation and retention of toxins in the alimentary tract.

It is generally recognized that there are two types of "convulsive puerperal toxæmia": one which seems to be due to primary kidney pathology, and one, the true eclampsia, in which the first changes are found in the liver with nephritis as a secondary complication. The treatment is the same in both cases.

The etiological theories which have had the strongest support are: (1) infection; (2) glandular dysfunction; (3) incompatibility between fetal and maternal blood; (4) fetal toxins; and (5) diet and faulty elimination.

Stroganoff has shown the similarity between eclampsia and acute infections, noting the mode of onset, the effect on all parenchymatous organs, the fact that there seems to be an epidemic form, and that one attack seems to confer immunity. Talbott found sepsis in the teeth of all of 97 eclamptics and believes that kidney damage resulting from these foci of infection is the primary cause of eclampsia. McIlroy stresses dental prophylaxis in the prevention of toxæmia. Focal infection is also blamed for the formation of placental infarcts which result from thrombosis of the uterine vessels. Frequent hæmatogenous infections of the kidney by colon bacillus have been noted.

Pathology of every endocrine gland has been suggested as a cause of eclampsia. It is believed by some that the physiological hypertrophy of the thyroid during pregnancy serves to promote the increased liver metabolism made necessary by pregnancy. When the thyroid does not enlarge during pregnancy, toxæmia should be anticipated. Kosmak reports a case of profound toxæmia in a thyroidectomized patient. Hypertrophy of the parathyroids has been urged as a cause. On account of its similarity to parturient paresis in cattle, a disease which is undoubtedly due to activity of the mammary gland, it has been thought by some that eclampsia is due to derangement of the milk-forming function of the human breast. Willson's comparison of the two conditions is striking. Hofbauer and others assert that the convulsions are due mainly to exaggerated activity of the hypophysis cerebri during pregnancy which causes vascular spasms in the brain.

A number of observers were convinced that the cause of eclampsia could be found in incompatibility between the fetal and maternal blood. Further investigation, however, tends to show that the blood group has no influence. According to Young, when interference with the maternal blood supply causes infarcts and partial separation of the placenta, autolysis of the placenta liberates toxic substances and toxæmia ensues. Willson and Williamson have pointed out the relationship between premature separation of the placenta and toxæmia. Veit believes that a distinct toxin, syncytiotoxin, is to be found in the maternal blood.

The effects of fetal toxins and anaphylaxis are believed by many to be the cause of eclampsia. Levi-Solal and Tzanck have found in the serum of eclamptics two toxic principles, one convulsive, the other lethal. They believe that susceptibility

[1] Read before a meeting of the Washington Medical and Surgical Society, December 29, 1924.

to toxin is due to variation of sympathetic tone, and experimented with drugs acting on the sympathetic nervous system. Pilocarpine used on guinea pigs was successful in combating the action of the lethal dose of eclamptic serum. One patient who had had nine convulsions was given 5 milligrams of pilocarpine 3 times in 24 hours. She had no convulsions after the first dose and recovered. The work of these authors helps to disprove the agglutination theory, as they found that after inoculating animals with eclamptic serum, injection of sodium citrate prevented coagulation but not death.

The influence of diet and faulty elimination has practically been proved by the clinical results of treatment directed toward the correction of errors in these particulars. Warnekros showed that in Germany during the war, eclampsia was much less frequent. At that time there was little fat and protein to be had and pregnant women were forced to live on a low protein diet.

In treating eclampsia, one should bear in mind all the possible causes and direct his efforts toward combating them. The chief difficulty lies in placing proper value on the various etiological factors. At present obstetricians are divided into two schools, one believing that removal of the products of conception is all important, and the other preferring to treat the toxæmia primarily, leaving the evacuation of the uterus to nature or to nature slightly assisted.

The evil consequences of accouchement forcé and other brutal methods of rapid delivery caused the obstetricians of former days to devote their efforts toward more conservative means of treating eclampsia. Then, with the advent of asepsis and the increased safety of cæsarean section, delivery by the abdominal route came into favor. This is without doubt the easiest way in which to terminate pregnancy, and if simple evacuation of the uterus would cure eclampsia there would be no need for further investigation of the subject. It has been shown, however, by statistics gathered from the whole world, that the mortality following cæsarean section in eclampsia is over 30 per cent.

Originated by Stroganoff and popularized by Rotunda Hospital, a conservative method of treating eclampsia and pre-eclamptic toxæmia has, with many modifications, been widely adopted. Though carried out in various ways, the principles of treatment are constant. The objectives sought are sedation, elimination, and, in some cases hastening evacuation of the uterus. Eden concludes, after a study of the methods of treatment in England that natural delivery, assisted delivery, or induced labor give twice as good results as cæsarean section. In general, the mortality after conservative treatment is 10 per cent.

Stroganoff uses chloroform and chloral hydrate as sedatives. In this country we are taught that these drugs cause liver necrosis and therefore are contra-indicated in eclampsia. At Rotunda, morphine is used, though not in the massive doses formerly recommended.

In the obstetrical service at Freedmen's Hospital, we have attempted to employ in the treatment of eclampsia every method which seems to have value.

We believe that the convulsion in itself is a source of grave danger. As Stroganoff says, the convulsion causes temporary asphyxia and cardiac dilatation, an increase in nervous irritability and depression of the kidney secretion. The general muscular contraction increases the amount of toxin thrown into the system, weakens the organism, and hastens the fatal outcome. We attempt to control convulsions by the use of morphine. One-half grain is given hypodermically at the first convulsion or when the patient is first seen. One-quarter grain is given with each succeeding convulsion until the respirations fall to ten per minute. We feel that whatever "locking up of secretions" may be caused is more than offset by the sedative effect. We believe also that the effect on the fetus is negligible. No anæsthetic is used to control convulsions. A general anæsthetic prevents the inhalation of air. What the patient needs is oxygen, and after each convulsion a few breaths of oxygen are administered to combat cyanosis.

Elimination is effected by stomach lavage until clear return, and colonic irrigations of 5 gallons of fluid. For each of these procedures we use 5 per cent sodium bicarbonate solution. After the lavage 2 ounces of magnesium sulphate are introduced through the tube. Neither of these treatments is given until after the patient is well narcotized by the morphine as such manipulations tend to induce convulsions. Formerly the colonic irrigation was repeated several times at 4 hour intervals. We have found, however, that one flushing seems to clear the bowel and we try to avoid further disturbance of the patient.

If the blood pressure is above 170 millimeters venesection is performed. We consider this procedure to be of the greatest importance. By it we lower the blood pressure, relieve the heart, lessen œdema of the brain, and probably remove actual toxin. We withdraw 600 to 1000 cubic centimeters or less if the blood pressure falls to 150 millimeters.

Lawrence explains the effectiveness of these procedures on the ground that morphine, gastric lavage, and colonic irrigation incite antibody production while delivery and venesection check production and distribution of fetal toxins.

After venesection, we employ 10 per cent glucose solution intravenously to the amount of 500 cubic centimeters hoping thereby to aid in the regeneration of damaged liver tissue. The suggestion of Thalhimer that insulin be used to increase carbohydrate metabolism has not yet been carried out. Acidosis is also combated by retention enemata of 6 ounces of glucose and soda, 5 per cent solution of each, every 4 hours.

We do not induce profuse sweating, believing that in doing so we concentrate the toxin in the blood and unduly depress the patient. She is kept warm, and usually in a gentle perspiration by means of hot water bags. Veratrum viride is not used. This drug will reduce blood pressure, but does nothing toward removing the cause of the disease. Pituitrin is not used in any stage of the treatment.

Unless the second stage of labor is very rapid, we hasten delivery after full dilatation of the cervix, by forceps or version. Cæsarean section is reserved for the primipara with an undilated cervix in the occasional case which does not improve under conservative treatment. Now and then, in spite of the treatment outlined above, the blood pressure remains high, coma is not lessened, and convulsions continue. Then cæsarean section is performed if the condition of the cervix will not permit delivery through the vagina. We are convinced that time utilized in procuring elimination and sedation is time well spent, and that this preparation increases the likelihood of recovery after the operation.

The series of cases to be reported is too small to be taken as proof of the efficiency of the conservative method of treating eclampsia. It is presented as an addition to the mass of evidence which has accumulated and is simply a record of the work of the past year at Freedmen's Hospital.

Eighteen cases of severe toxæmia were admitted. Three were not having convulsions and were classed as pre-eclamptic toxæmia. Two died almost immediately after reaching the hospital, before any treatment could be instituted. Remaining are 13 cases of eclampsia which were treated.

In 3 cases cæsarean section was performed as soon as possible after admission. All 3 patients died—one 1½ hours; one 2 days; and one 3 days after operation—a mortality of 100 per cent.

Of the 10 patients treated conservatively, all lived, a mortality of 0 per cent. Two of the 10 were admitted in coma with convulsions, recovered, were discharged, and returned later to be delivered of living babies. One patient, a primipara was delivered by cæsarean section after thorough elimination and sedation.

Fortune is undoubtedly responsible in part for this striking contrast in the results of two methods of treatment. All cæsareanized eclamptics do not die, and many eclamptics will die in spite of all treatment. Our results, however, have caused us to be firmly entrenched on the side of conservatism.

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CORRESPONDENCE

THE CORPUS LUTEUM AS THE SOURCE OF THE FOLLICULAR HORMONE

To the Editor: From the article of Charles G. Johnston and Victor L. Gould entitled "The Corpus Luteum as the Source of the Follicular Hormone" which appeared in your journal in February (1926, xlii, 236), it is impossible to determine when the experimental work was completed and on what date the manuscript was given into your keeping. Whether or not completed before June 6, 1925, it certainly must have been feasible, at least during the final revision of the proof, to have considered the article of Robert T. Frank and R. G. Gustavson entitled "The Female Sex Hormone and the Gestational Gland" (J. Am. M. Ass., 1925, lxxxiv, 1715, June 6) which more than covered the ground of Johnston and Gould's research and which explains why these authors obtained negative results with corpus luteum. The questions involved are of such fundamental importance to the profession that I feel justified in correcting the impression conveyed by Johnston and Gould.

The only deductions that can be drawn from their paper are (1) that the authors have overlooked some of the recent literature; and (2) that they have failed to obtain potent corpus luteum extracts.

An analysis of Johnston and Gould's article shows that 23 different corpus luteum preparations were injected into 42 rats (Table I) and that 4 corpus luteum preparations were injected into 4 immature rabbits (Table II). The results were uniformly negative in both series.

The method of preparation of the corpus luteum extracts was according to the procedure described by Doisy, Ralls, Allen, and Johnston (J. Biol. Chem., 1924, lxi, 711) which may be summarized as a fractional extraction by means of alcohol, acetone, and ether, differing in but minor ways from the methods described by the pioneer, Iscovesco, in 1912 (Compt. rend. Soc. de biol., 1912, lxxiii, 104) and since then utilized with variations by practically all the workers on this subject.

Much emphasis is justly placed upon the employment of fresh ovaries in order to avoid postmortem diffusion, and the shelling out of corpora lutea by skilled personelle in order to avoid inclusion of follicle fluid with the corpus luteum mass because this error would becloud the result.

The amount of tissue employed to obtain extract in the rat experiments, varied between 10 and 60 grams. The authors do not state whether this represents the amount given each animal or distributed among 1 to 6 animals, nor do they record the amount of lipoid obtained by extraction. Therefore, no exact comparisons of our work and theirs is possible.

Table II, which deals with the injections into normal immature rabbits, will not be considered, because in a previous paper, Johnston as well as Allen, Doisy, et al. (Am. J. Anat, 1924, xxxiv, 133) objected to my use of "virgin" rabbits, "*presumably adults*" (the italics are mine) "with ovaries intact." This addition of the phrase "*presumably adults*" is, indeed, pure presumption on the part of these authors, as in a letter (J. Am. M. Ass., 1923, lxxxi, 1133) in which I drew attention to another misquotation of my work by Allen and Doisy, I specifically stated that "I have used immature animals long before œstrus could occur . . . ." This letter was replied to by Allen and Doisy and therefore noted. However, to avoid any possibility of further misinterpretation, misunderstanding, or misquotation, I will not refer to the numerous experiments performed on rabbits, although their validity cannot be questioned, but will confine my proof entirely to the smaller series of material tested on castrated rats by the vaginal smear method of Stockard and Papanicolaou.

In the subjoined table our positive results only are recorded, but emphasis must be placed on the fact that in our preliminary work *47 batches or fractions proved negative.* Twenty-seven batches proved positive, and after errors and pitfalls of preparation had been mastered, all of the last 10 batches gave positive results.

As detailed in our article (J. Am. M. Ass., loc. cit.) we found the active female sex hormone present in all corpora lutea, most in yellow and least in the bloody or early corpus luteum. This seemingly bizarre fact is explained by the early vascularization of the yellow body immediately after follicle rupture, which allows the hormone secreted by the corpus luteum cells to pass into the blood stream where we have demonstrated its presence (Frank, Frank, Gustavson, and Weyerts, J. Am. M. Ass., 1925, lxxxv, 810) and prevents the corpus luteum from being a storage gland. Only when the capillary network begins to obliterate during involution (at the stage corresponding to the microscopic appearance of "yellow") does storage of hormone temporarily occur.

POSITIVE RESULTS OBTAINED WITH CORPUS LUTEUM EXTRACT BY THE VAGINAL SMEAR METHOD IN CASTRATED RATS

Material	No. Rats	Total amount in milligrams	Source	Preparation
63			Hog	Protein precipitation.
68	5-6-7	55	Hog	Alcohol ether.
69	8-9	100	Hog	Alcohol ether.
95	12-13	50	Hog	Protein precipitation.
100	12	125	Hog	Saponification.
107	8-13-14	90 and 150	Hog	Alcohol ether, yellow pink.
109	26	150	Hog	Alcohol ether, yellow.
105	23		Hog	Protein precipitation, yellow.
118	23	75	Hog	Pregnant, small.
119	26	75	Hog	Pregnant, large.
120	2	120	Hog	Pregnant, small.
130	18	100	Hog	Saponification.
132	23	100	Hog	Saponification.
169		75	Hog	Minus phosphatides.
175	12	75	Hog	Saponification.
177	23	75	Cow	Minus lecithin, cephalin, and some cholesterol.
178	27	75	Cow	Minus lecithin, cephalin, and some cholesterol.
185	42-44	75	Hog	Minus cholesterol.
197	50	28	Hog	Minus lecithin, cephalin, and some cholesterol.
199	80	80	Hog	Alcohol ether, pink.
200	23	80	Hog	Alcohol ether, yellow pink
201	24	80	Hog	Alcohol ether, yellow.
202	27	45	Hog	Yellow and pink, minus cholesterol.
210	47	75	Hog	Bloody, minus cholesterol.
211	37	75	Hog	Pink, minus cholesterol.
212	49	75	Hog	Yellow pink, minus cholesterol 18 hours.
213	52	75	Hog	Yellow, minus cholesterol 18 hours.

Our material consisted mainly of hogs' ovaries. First the follicle liquid was aspirated. Next the corpora lutea were shelled out with a sharp spoon, washed twice thoroughly with running water, then washed with normal salt solution, and finally blotted to remove excess fluid in order to eliminate all contamination with follicle fluid. The material was then ground and extracted with various lipoid solvents. "Total Amount" signifies amount given to each animal.

It is of interest to note the amount of the cholesterol found in the lipoid fraction of the following tissues:

	Per cent
Bloody corpus luteum	53.5
Yellow corpus luteum	32.9
Follicle fluid	17.88
Placenta, human	16.93

After concentration obtained by eliminating the cholesterol, lecithin, and cephalin from these fractions, the minimum total amount necessary to produce a positive reaction in the castrated rat was:

Follicle fluid lipoid	15 mgm. average
Placenta lipoid	37 mgm. average
Corpus luteum lipoid	75 mgm. average

which, while it gives a rough comparison of the potency of artificial extracts, supplies no estimate of the amount of hormone set free in the blood stream.

Why did Johnston and Gould fail to obtain positive results with corpus luteum extracts? The reason is twofold: (1) They evidently failed to concentrate the extract sufficiently—just as we failed in our earlier work; and (2) gave subthreshold doses. In eliminating protein and cholesterol (the latter representing over 50 per cent of the lipoid mass), the hormone readily may be lost. Moreover, the dosage, as our results show, must be five times that of follicle lipoid and twice that of placental material.

It might further be argued that the hormone obtained by us from corpus luteum is different from that derived from the follicle fluid but the chemical researches of my collaborator, Gustavson, have shown that the female sex hormone, whether obtained from follicle fluid, corpus luteum or placenta, can be freed from all nitrogen, phosphorus, cholesterol, and cholesterol reactions; that from whatever source derived, it shows the same chemical properties and the same composition (C, H, perhaps O).

And finally tested by the reaction produced on the contraction rate of the isolated uterus of the rat, follicle corpus luteum and placental extracts were found identical in action (Frank, Boncham, and Gustavson, Am. J. Physiol., 1925, lxxiv 395).

It is therefore apparent that to call the female sex hormone the "ovarian hormone" or "ovarian follicular hormone" as Johnston, Allen, and Doisy, etc., have proposed, is inadequate because the female sex hormone is secreted not only by follicle, but also by corpus luteum and placenta.

In order to emphasize this multiple derivation, as well as to mark its physiological purpose, we (Frank and Gustavson, loc. cit.) have proposed the name of *gestational gland* for the three structures which secrete the female sex hormone. The purpose of the female generative tract is for procreation. The female sex hormone, through the secretion of the follicle, initiates the pregravid pelvic and mammary reaction up to the time of ovulation. After ovulation has taken place, the corpus luteum further accentuates the reaction and continues it until the yellow body becomes functionless, if the sex cycle proves abortive (infertile). If impregnation supervenes, the placenta protracts the cycle throughout pregnancy and brings the necessary tubular (vaginal and uterine) as well as mammary hyperplasia to its acme and conclusion, ending with birth of the young. Unless these fundamental facts are recognized, the physiology of sex and reproduction remains unexplainable and obscure.

ROBERT T. FRANK, M.D., F.A.C.S.
New York City

To the Editor: In a criticism of our article, "The Corpus Luteum as a Source of the Follicular Hormone," which appeared in your journal (February, 1926), Dr. R. T. Frank states that there are but two deductions that can be drawn from our paper, namely: (1) that we have failed to read some of the recent literature, and (2) that we have failed to obtain potent corpus luteum extracts.

Dr. Frank's first deduction is based on the fact that we did not refer to an article by him and R. G. Gustavson (J. Am. M. Ass., 1925, lxxxiv, 1715). It is apparent that this deduction is based on entirely fallacious reasoning. After we mailed our manuscript to you we read and discussed their article and were fully cognizant of its contents. We

did not think it necessary to revise our galley proof, as the results described in this and other papers which appeared after we had mailed our manuscript, did not alter our conclusions.

The second deduction drawn by Dr. Frank, concerning our failure to obtain potent corpus luteum extracts, is in complete accord with our conclusions.

In regard to the amount of extracted tissue injected, we wish to state that each animal was considered individually and that the amounts stated were injected into one animal.

There can be no basis for comparison of Dr. Frank's results with our own until the details of his chemical procedures are made available. Doisy, et al. (J. Biol. Chem., 1925, lix, 43) clearly state their method of preparation and the number of rat units obtainable from a definite amount of material, as well as the total amount of solids in each rat unit. We stated that we prepared our extracts after the same procedure used by Doisy, et al., and also give the weight and character of corpora lutea which failed to yield one rat unit.

As regards the freshness of the material used by Dr. Frank, we fail to find any reference to this important point. We feel that the only safe way to collect material for work such as is under discussion is an immediate removal of the corpora lutea from the ovary as it is removed from the freshly killed animal.

In regard to the discussion of the gestational gland, we are forced to admit that we know nothing about the gland except as we have read of it from the articles of Frank and his collaborators. Aside from this source of information, we can find no reference to this gland so that our discussion upon this point would not be very illuminating.

We cannot agree with Dr. Frank in his closing statement about accepting his ideas regarding the gestational gland, for even if we accept his statements as true, the physiology of sex and reproduction remains more or less a puzzle and a rich field for careful and painstaking research.

St. Louis, Missouri CHARLES G. JOHNSTON
VICTOR L. GOULD

EDITORIALS

SURGERY, GYNECOLOGY AND OBSTETRICS

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APRIL, 1926

"KEEP THE HOME FIRES BURNING"

WHEN in January the surgeon takes account of stock with regard to the mortality results for the year just past, he is often chagrined over the finding that the percentage of deaths is greater than he had expected. But truth is stranger than fiction, and occasionally (because he has been more impressed by his failures than by his successes) further investigation reveals that the results are really better than he had expected.

My brother counsels that when a patient writes a letter of praise, it should not be read, but that when a letter of the opposite type is received, in which our demerits are carefully depicted, we should go over it with great care, because we would probably learn something.

I have been reviewing our surgical work of last year. The deaths have been divided into three groups. In the first group are the "too-lates," cases in which we did our best and, in the light of our present knowledge, could not do very much better if we had a second chance. In the second group are the cases in which our foresight was thoroughly discredited by our hindsight. In other words, if we had known in advance what we knew afterward, some of these deaths might have been avoided. In the third group are the cases in which the general condition was bad, but in some of which the patients might have lived if methods of rehabilitation had been carried out before operation.

It is to this problem of rehabilitation before operation in certain types of surgical cases that I have been giving thought. That my keen-minded young colleagues have caused me to give thought to this subject and that I have been the agent by which the benefits of their researches have been conveyed to the patient, would be the better way to put it.

Life is a matter of combustion, a union of the carbon of food with the oxygen of the air carried from the lungs by the red blood cell. It is only as oxidation takes place that vital processes can be maintained, and of these processes, the production of bodily heat and antonomic energy is fundamental. A patient can be placed in bed and kept so quiet that the production of energy is reduced to a minimum, so far as the 25 per cent under conscious control is concerned, but the fires must be kept burning to maintain energy in the vegetative system and to heat the body.

Hill, in his classical experiments, showed that the glycogen, which is produced in the liver and which is merely glucose with one molecule of water abstracted, is converted into lactic acid in the muscles of the controllable system at least, that the accumulation of this acid in the muscles gives the sense of fatigue, and that under violent exercise the lactic acid, normally amounting in the

blood from 0.02 to 0.03 per cent, may be increased to 0.2 or even 0.3 per cent. It seems reasonable to suppose that production of energy takes place in the same way in the nonstriated muscles. One of the most interesting side lights on this study of lactic acid is the reconversion of the acid ($C_3H_6O_3$) in the muscles into glycogen ($C_6H_{10}O_5$), as the oxygen debt is paid, with a loss of one molecule of lactic acid in every five reconverted. It is interesting to note that two molecules of lactic acid make the glucose molecule ($C_6H_{12}O_6$) with which we are familiar.

There is a large group of toxæmias secondary to various acute diseases, such as the high intestinal obstructions, in which the body cannot convert foods into fuel, and the fire goes down and often out. The drop in bodily temperature, low blood pressure, coldness and clamminess of the skin, small rapid pulse, dry tongue, and sordes on the teeth are tragic manifestations of a deadly toxicity.

Carbon, oxygen, and hydrogen are the chief constituents of all food. Carbohydrates are the simplest form of fuel. Proteins, in addition to carbon, oxygen, and hydrogen, contain nitrogen and usually a little sulphur. The nitrogen in some manner enables proteins to take on form and give stability to the tissues and permits the deposition of other elements, such as calcium. Fats contain carbon, hydrogen, and a little oxygen, but require a great amount of oxygen for conversion into fuel, and the hydrogen is but slowly pried free from the carbon. Fats serve an extraordinary purpose, however, producing not only heat, but also water, which explains the ability of the camel with its hump, and of the hibernating animals with their autumn fat, to go for long periods without food or drink.

The sugars are produced under normal conditions in the liver from the digested carbohydrates, and are the cheap, easily obtained fuel, the common coal of our existence. Glucose can be artificially produced outside the body in almost the form that it is used within the body. The conversion of the amino-acids of the proteins, the anthracite coal of the body, into sugar is a slower process and more expensive, and in the acute conditions under discussion usually means burning the body tissues and failure of elimination of the creatinin and urea, the ashes, from the blood. The use of fat as a fuel to produce heat and energy is too slow a process to save life in acute conditions.

It has been pointed out by a number of observers, particularly by Matas, that the intravenous introduction of glucose solutions brings up the body temperature and gives to the vegetative system the energy necessary to life. Glucose given with large quantities of physiologic sodium chloride solution restores the chloride deficiency and also aids the elimination of the urea and creatinin. Now that we have, by means of examination of the bood, developed methods of precision for determining metabolic changes, many patients apparently moribund can be lifted out of the pit, so to speak, and enabled to undergo a life-saving operation that would have been otherwise impossible.

W. J. Mayo

DIATHERMY

DURING the last 25 years the position of electrotherapy in America has been one of almost total eclipse, largely because it had been allowed to fall into the hands of quacks, both in the profession and out of it, and because disciples of the various cults had recognized in it a means of widening their scope and increasing their prestige. Under such circumstances, it was but natural that conscientious physicians generally should not only look askance at this method of treat-

ment, but be prepared to condemn unheard any modifications of it. In Europe during the same period the situation was quite different, because there electrotherapy had remained in the skilled hands of trained experts.

The war and its frightful mutilation of millions of human bodies provided an exceptional opportunity for testing out and demonstrating the usefulness of electrotherapy and physiotherapy. This demonstration made a strong impression on many American physicians who went to Europe to observe the methods employed in treating the wounded, and since then a revival of interest in electrotherapy and physiotherapy has been evident. At the present moment, this interest is largely centered on diathermy.

The painful sensations produced by passing an ordinary 60-cycle alternating current through the body are due to its relatively low frequency, each alternating impulse being perceived as painful, incomplete, muscular contractions. If the alternating frequency is sufficiently increased, painful contractions no longer take place and the only sensation is one of heat. Diathermy, therefore, is nothing more nor less than an improved method of employing heat as a therapeutic agent. It provides an almost ideal means of delivering as much heat as may be desired where it is needed. The heat may be diffused over the entire body or it may be concentrated through any region or at any point, merely by changing the relative position and size of the opposing electrodes.

When diathermy is used to raise the temperature of some part of the body and the heat is not carried to the point of tissue destruction, it is called "medical" diathermy. "Surgical" diathermy implies actual destruction of tissue by concentrating the heat at one point and can be varied within fairly wide limits by means of suitable electrodes.

The scope of medical diathermy will undoubtedly be enlarged, but its value in many forms of inflammation without suppuration, such as sprains, simple arthritis, and the inflammatory reactions accompanying fractures, has been amply demonstrated. The exudates resolve, repair is speedier, and convalescence shortened. Myositis, whether acute or subacute, and neuritis respond extremely well. Certain forms of gonorrhœal inflammation likewise yield quickly to the treatment. If nothing more could be said of diathermy than that it relieves pain and reduces swelling promptly, it would have a permanent place in therapeutics.

In the chronic forms of arthritis the effect of diathermy is not so uniformly striking; in many cases partial or complete relief from pain and reduction of swelling are obtained, but in others the results are indifferent. If treated early, trophic lesions due to vascular changes can sometimes be stopped and much damage prevented. General diathermy (autocondensation) greatly relieves the itching and insomnia associated with jaundice. In essential hypertension the blood pressure can be considerably reduced for several hours, but this reduction is transitory. Diathermy has been advocated in pneumonia, but it has not been given a serious trial.

The surgical indications depend largely on the expertness of the individual operator and range from keratotic patches, warts, moles, melanomata, and epitheliomata to relatively bulky superficial tumors or such as can be reached from the surface. The advantages of diathermy are that the cosmetic results are better, that it can be repeated as often as necessary, and that it minimizes hæmorrhage and malignant dissemination by causing thrombosis of the blood in the vessels and coagulation of fluids in and around the lesion treated.

Diathermy is contra-indicated in suppurative conditions until provisions for adequate drainage have been made. The tendency to employ diathermy promiscuously and without real indications is to be deprecated; instead of diminishing the widespread influence of the cults, it can only serve to increase those evils. The secret of the advantageous use of diathermy lies in the thorough understanding of the underlying principles, the careful selection of patients and the close attention to the many details of such treatment. In many patients diathermy alone is not sufficient to bring about the best results; it must be combined with other forms of electrotherapeutics or physiotherapy. Hence, in any well-organized clinic or hospital, diathermy should simply form a part of the electrotherapeutic and physiotherapeutic armamentarium and should best be concentrated under one direction. Since the fundamental training of the radiologist enables him readily to master the principles of high frequency apparatus, he is specially designated to take up the method. In nearly all of the European clinics the radiologist and the electrologist are either one and the same person, or they are associated in the same department.

Recently an intensive commercial propaganda has led many physicians to take up diathermy without adequate preparation. The blame can hardly be placed on the manufacturers, who are actually in advance of the profession; it must fall on those who allow themselves to be induced to purchase such apparatus without knowing anything about the principles of its construction or about the proper application of the method. It is true that some of the manufacturers are offering short courses of instruction, generally covering one week. Of course, it is obvious that all one can learn in that time is how to operate the apparatus and something about its construction, but the mere idea of physicians going to manufacturers of apparatus for information on the indications and contra-indications for this or that form of treatment constitutes an anachronism. The growing vogue of electrotherapeutic and physiotherapeutic methods due to increased knowledge of their scientific basis and to better instrumentation makes it imperative that our medical schools reconsider the subject and provide sound courses of instruction. No longer should physicians have to seek such information at the shop of the instrument maker.

A. U. DESJARDINS.

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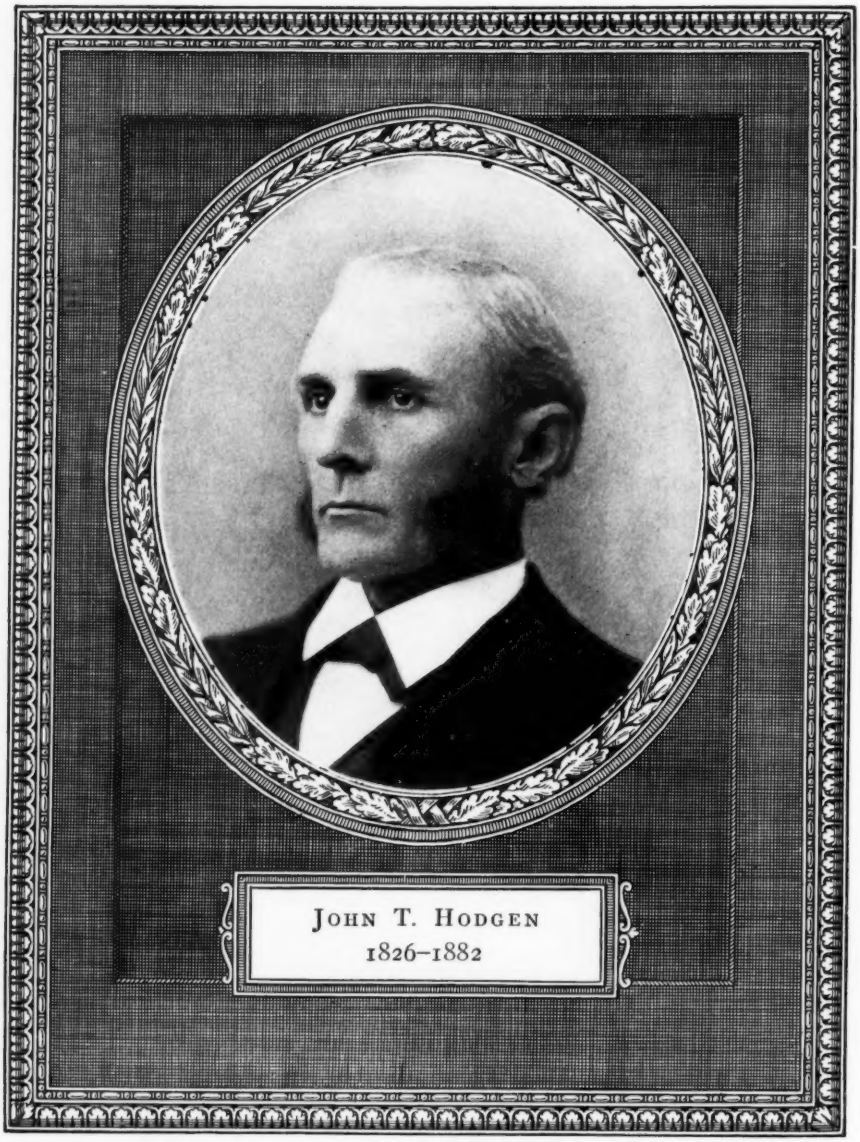

JOHN T. HODGEN
1826–1882

MASTER SURGEONS OF AMERICA

JOHN THOMPSON HODGEN

JOHN THOMPSON HODGEN was born at Hodgensville, La Rue County, Kentucky, January 29, 1826. His father was Jacob Hodgen, his mother Frances Park Brown. His early education was received in the county school at Pittsfield, Illinois. Later he attended Bethany College in West Virginia. In March, 1848, he graduated from the medical department of the University of the State of Missouri, at that time known as McDowell's College. He served as assistant resident physician and afterward as resident physician to the St. Louis City Hospital from April, 1848, to June, 1849.

He began his work as a teacher in 1849 as demonstrator of anatomy in the Missouri Medical College, was professor of anatomy in 1854, being appointed by Dr. Joseph Nash McDowell, and filled this chair until 1858. Subsequently he filled the chairs both of anatomy and physiology from 1858 to 1864.

During the Civil War he served as surgeon general of the Western Sanitary Commission, as surgeon of the United States Volunteers from 1861 to 1864, and as surgeon general of the State of Missouri from 1862 to 1864. He was consulting surgeon to the St. Louis City Hospital from 1862 to 1882 and from 1864 until his death in 1882, he taught clinical surgery at the City Hospital.

In 1862 he was called to the St. Louis Medical College, filling respectively the chairs of physiology and anatomy. On the resignation of Dr. Charles A. Pope in 1865 he was made Dean of the College, which position he occupied until his death. He was honored by the local profession as president of the St. Louis Medical Society in 1872, was chairman of the surgical section of the American Medical Association in 1873, and served as president of the Missouri State Medical Society in 1874. He was one of the original members of the American Surgical Association. He was president of the American Medical Association in 1881.

He died April 28, 1882, after an illness of 2 days, of acute peritonitis, caused by a pin hole perforation of a small ulcer of the gall bladder.

For 33 years Dr. Hodgen was a teacher. A keen and accurate observer, his interest was not limited to the sick room. He was a student of nature, quick to grasp and interpret its laws aright. Alert to all the phenomena of life, his wonderfully active sympathy with every phase of human nature gave him powers of illustration which fixed facts in the mind of a hearer in a way to make them

truths not to be forgotten. In the East and the West, in the North and the South, his fame as a teacher is a glory to St. Louis. He was exceptionally concise, practical, and comprehensive. As a teacher of surgery he was incomparable. His influence was, however, impressed not only upon individuals, it also controlled institutions. As dean of the faculty of the St. Louis Medical College he originated and consummated measures for its establishment on the basis of learning. During the time that he was a potent factor in shaping its course the St. Louis Medical College established an advanced standard of work which no other institution in St. Louis dared to attempt until years later and then only under the pressure of enforcing laws.

The high standard of the work of Washington University and the steady advance in the demands of the St. Louis Medical College, not only upon the students, but upon the earnestness, the unselfishness and the capability of the teachers, finally led, some years after the death of Dr. Hodgen, to the union of the two institutions in the way that he had anticipated and desired. Dr. Hodgen's last public speech was made before the alumni of the Washington University. That speech was the echo of his life's striving, a cry for "more knowledge, more light." As a surgeon he was conservative always, but quick, precise, and dexterous. The quick precision of his actions was but the outward sign of a mind singularly active and exact.

The difficulties of a case never seemed to surprise or overwhelm his judgment. He had resources at command adequate for any emergency. His keen powers of observation, ever on the alert, quickly seized the phenomena of disease and with precision his analytical mind traced them to their causation and led him to just conclusions as to the nature of the disease and its rational treatment.

He had, to a noteworthy degree, mechanical genius, which found play in the application of mechanical means to the uses of surgery. Extensive observation with vast experience inspired his creative faculties, which ever evolved original thought, new methods, and admirable instrumental inventions. The most noteworthy of his inventions were—a suspension splint for fracture of the femur, a modification of the Nathan R. Smith anterior splint, which was especially designed during the Civil War for the treatment of compound, gunshot fractures of the femur—a suspension cord and pulleys which permitted flexion, extension and rotation in fracture of the leg, a forceps dilator for removal of foreign bodies from the air passages without tracheotomy, a wire suspension splint for treatment of injuries or fractures of the arm, a hair pin dilator for separating the lips of the opening in the trachea in tracheotomy, an excellent adaptation of simple means to an end.

Dr. Hodgen's time was so fully taken up during the latter years of his life that his writings were not extensive. Among his contributions were articles on "Wiring the Clavicle and Acromion for Dislocation of the Scapular End of the

Clavicle," "Modification of Operation for Lacerated Perineum," "Dislocation of Both Hips," "Two Deaths from Chloroform," "Use of Atropia in the Collapse of Cholera," "Three Cases of Extra-Uterine Fetation," "Skin Grafting," "Nerve Section for Neuralgia," "Report on Antiseptic Surgery," and "Shock and Effects of Compressed Air as Observed in the Building of the Eads Bridge."

Dr. Hodgen had a big, warm, generous nature, well recognized by those who came to know him as he was; but these qualities sometimes went unrecognized because of a somewhat reserved, even austere manner. He was full of a kindly humor. His quick perception, ready, active, and all pervading sympathy inspired and made strong friendships. The poor and the afflicted looked with confidence to his helping hand. The rich and powerful knew that they dealt with a just and humane man. The city was rich in his presence. He was a refuge in sorrow and sickness. His fame as a surgeon was widespread.

He made for himself a place unique in the profession. No one before him had so clearly obtained first place in the hearts of the people and in the profession. The conditions now existing can never evolve a man of such wide and varied capacity. But man is for a brief time. He was cut off in the prime of life, in the zenith of his fame. As a great teacher and a great surgeon he exemplified the genius of humanity whose qualities abide from generation to generation but speak only now and then in the process of time in the individual.

He died as he had lived, "in the harness," a friend to humanity. He had always wished to go before his usefulness was in any degree impaired. Honest, frank, direct, a great soul; "We shall not see his like again." H. G. MUDD.

THE SURGEON'S LIBRARY

OLD MASTERPIECES IN SURGERY

By ALFRED BROWN, M.D., F.A.C.S., Omaha, Nebraska

ROGER OF SALERNO

ROGER of Salerno, more properly called Roger of Parma, was the first outstanding surgeon of Italy to write a surgery and not depend upon the Arabian school for his ground work. He was born during the 12th century and probably lived into the 13th. It is likely that he produced his surgery which was known by various names during the latter part of the 12th century. Two names of the book are the "Practica Chirurgiæ" and the "Post mundi Fabricam," the latter being derived from the first three words of the preface of the book. It was so far superior to anything that had appeared up to that time and contained so much original material, for it does not contain any of the Arabic teaching, that it was at once taken as one of the principal works for use in teaching at the school of Salerno. Thus it is one of the landmarks in surgery as it marks the breaking away of continental surgery from the influence of the Arabian school. The book was not wholly the production of Roger's thought but rather stated the opinions and beliefs of a new school of surgery which was founded on the work of the old Greek masters with the results of original observation added. Who his collaborators were is not definitely established, as Roger does not mention them by name but states simply that others helped and he wrote the book. The detail of giving credit to others by name was frequently omitted about this time and a little later.. Constantinus Africanus, for example, does not mention the source from which his work was obtained though much of his writing was word for word translation of such authors as Haly Abbas Filius, Costa Ben Luca, Ishak Ben Soleiman and others. Following Roger was his pupil Roland, who rearranged his work and published it under his own name, though he does give credit to his master. He does not state, however, that much of it is copied word for word. Whether this plagiarism was intentional or not it is hard to establish as the writings were handed down in manuscript form for nearly three centuries and there was thus considerable chance of error. In the case of Roger of Parma and his pupil Roland I have had the opportunity of making a comparison between an original manuscript[1] of the thirteenth century (see illustration) and a printed book[2] of 1541. The manuscript is on vellum, beautifully illuminated and is made up of 36 folios written in different 13th century hands. It contains among other things, part of the surgery of Roger appearing under various headings. There is of course no title but above the initial letter is the statement: "Here beginneth the surgery of master Roger." Then comes the famous introduction beginning with the lines by which it is known "Post mundi Fabricam." "After the formation of the world and setting it in order God made man of earthly substance and breathed the breath of life in him," etc. Following the introduction is the table of contents and then the text of the book. The other volume carries us on a few centuries. It was printed by Henricus Petrus at Basle in 1541 and contains a book, the title of which freely translated reads: "A rational method of curing the ills of the human body, internal and external written by Roland." Under the heading "Præfatio" we read again the well known words "Post mundi Fabricam" and so on. Going on further we find that save for an occasional word or change in phraseology the manuscript and book are the same. The disciple has taken the words of the master, arranged them a little better, and made the work more understandable. In some places he may have added a little new material but the chief change, and one for the better, is the arrangement. Roger did, however, write one part of surgery which remained his even to as late as the 16th century for we find in this volume of 1541, eight pages devoted to a description of phlebotomy ascribed to Roger under the title "De Modis Mittendi Sanguinem et de cuiusque utilitate Rogerii chirurgi peritissimi Libellus." In this work Roger gives the indications for phlebotomy and where the incisions should be made. For disease of the gums, mouth or teeth he advises incision of two veins under the tongue. His indications are at first general and then methods are given in detail. In one general statement he says "of the hip, tibia, and foot we incise veins because of pain of the kidney and bladder, and because of rheumatism, sciatica, and podagra, and constriction of the eyes, and swelling which affects the legs and feet, or on account of withdrawal of the menses or when women do not conceive." The last two seem to be rather contrary indications. Roger well deserves to be considered the father of the new surgery in Italy if not in Continental Europe.

[1] Courtesy of Dr. LeRoy Crummer, Omaha, Nebraska.
[2] Courtesy of the John Crerar Library, Chicago.

REVIEWS OF NEW BOOKS

THE modern tendency to present anatomy in more concise form is again exemplified in a little volume in paper covers which the authors, Pauchet and Dupret,[1] rightly call a "pocket anatomy." Although containing no text whatever, the essentials of gross anatomy are very well covered in its 316 pages of simple, well drawn pen and ink illustration —many of which are semidiagrammatic.

One cannot help but regret that the authors did not see fit to use the international or BNA terms in labeling the figures as the French terms used would tend to limit the book's usefulness to that country.

TOM JONES.

TURNER'S little book[2] of seventy-five pages with illustrations dealing with cancer surgery presents the substance of a lantern demonstration before the surgical section of the Royal Society of Medicine.

The purpose of the writer is to draw from the wealth of his surgical experience such instances of the operative treatment and cure of cancer in its different situations as will serve to prove the axiom that the most certain and reliable method for the cure of cancer is the "well-executed surgical excision of the growth together with the path of probable cancer invasion while the disease is still local."

The cases have been observed for periods of from 5 to 16 years after operation and most of them have been supported by re-examination of the pathological material. Although few actual statistics are included, the individual case-histories are sufficient to accomplish the writer's purpose; which is to encourage his younger colleagues to deal with cancer by vigorous and thorough operative measures. R. B. G.

PART IV[3] of *Irrtuemer der allgemeinen Diagnostik und Therapie sowie deren Verhuetung* is now available. The work is divided into four parts. The first part, which comprises 221 pages or almost exactly half of the book, deals with mistakes and sources of error in roentgenological diagnosis and their prevention. This portion of the work includes some general remarks by Grashey of Munich; a chapter on bone and joint diseases by Grashey; one on the digestive organs by Lorenz of Hamburg; one on lungs, mediastinum and the diaphragm by Lorey of Hamburg; one on the heart and blood vessels by Groedel of Frankfort; one on the urinary organs by Haenisch of Hamburg, and one on foreign bodies by Grashey.

The second part, 198 pages, deals with errors and dangers in roentgentherapy and their prevention. This consists of the following chapters: General considerations, by Holfelder of Frankfort; surgical diseases, by the same author; gynecological diseases, by Reifferscheid and Schugt of Goettingen; skin diseases by Rost of Freiburg, and internal diseases by Salzmann of Bad Kissingen.

The third part, 24 pages, is a discussion of errors in light therapy contributed by Jesionek and Rothman of Giessen.

The fourth part, 21 pages, is devoted to errors in radium therapy, by Berven of Stockholm.

In the portion dealing with roentgenological diagnosis mistakes in the technique of fluoroscopy as well as errors in the detail of roentgenography, with the resulting confusion caused thereby, are pointed out. The common errors in interpretation of the normal findings are discussed and the reasons for the mistakes emphasized. The causes of false interpretation of pathological conditions are similarly dealt with. Numerous diagrammatic, but entirely satisfactory, drawings are used to bring out the points.

The portion dealing with errors and dangers of roentgentherapy is of exceptional interest. Holfelder contributes an unusually valuable 75 pages discussing in considerable detail the poisonous action of roentgen rays; idiosyncrasy to roentgen rays; the latent period of the action of the rays, and the time required to determine the dose administered; the dose required; the disadvantage of administering too little and the dangers of excessive dosage; the dosage required for specific tissues; the effect of distance and the absorption in the tissues; filtration; methods of measuring dosage; dosage in cross-firing; and other interesting information. The chapter ends with a consideration of the after-treatment. His chapter on errors in roentgentherapy in surgical diseases is likewise of exceptional merit, and of great practical value. In this chapter, as also in the chapters dealing with gynecological diseases, skin diseases, and internal medical diseases, the questions of the indications for, value of, details of technique of administration and dosage, symptoms to be expected and results that may be gained, are gone into in the minutest detail, so that this portion of the work constitutes a valuable handbook on this subject. The chapters dealing with light therapy and radium therapy are less extensive, but contain many valuable practical points.

The work as a whole is highly practical, clear-cut and to the point. The usefulness of the book is enhanced by a very good general index, and each chapter is preceded by a carefully prepared list of contents. The only criticism of the volume is the absence of a complete bibliography; however this would require too much space to be practical. Holfelder's chapters are the only ones which are followed by a bibliography.

[1] L'ANATOMIE EN POCHE. Victor Pauchet and S. Dupret. Paris: G. Doin & Cie, 1926.

[2] SOME ENCOURAGEMENTS IN CANCER SURGERY. By G. Grey Turner, F.R.C.S. (Eng.). New York: William Wood & Co., 1925.

[3] IRRTUEMER DER ALLGEMEINEN DIAGNOSTIK UND THERAPIE SOWIE DEREN VERHUETUNG. Edited by Prof. Dr. J. Schwalbe. No. 4 Irrtuemer der Roentgendiagnostik und Strahlentherapie. Edited by Prof. Dr. R. Grashey. Leipzig: George Thieme, 1924.

The book is of exceptional interest and should be consulted by physicians and surgeons as well as roentgenologists. DAVID C. STRAUS.

THE second volume of this elaborate three-volume work on the clinical aspects of malignant tumors, fully justifies the good opinion expressed in these columns concerning the first volume. The entire set covers in great detail an enormous field of the greatest practical significance to the surgeon. The various chapters have been written by men who are recognized masters in their specialties and who have brought their respective subjects down to date with many references to the literature of 1924. It is therefore worthy of an important place in the library of every surgeon. The editors and publishers are to be praised for the rapidity with which the several volumes of so compendious a work are being published, Volume I having appeared late in 1924, Volume II in June, 1925.

This second volume contains 742 pages with 48 full page colored plates and 267 illustrations which are of exceptional excellence.

The editors, P. Zweifel and E. Payr[1] of Leipzig, point out in their introduction that the best proof of the timeliness and the necessity of a clinical presentation of malignant neoplasms is presented by Lubarsch's statistical study covering 86,216 necropsies in 9.8 per cent of which cancer was diagnosed postmortem. The errors in the clinical diagnosis of external cancer amounted to 8.26 per cent, of which 5 per cent were mistakes as to the nature of the tumor, and 3.26 per cent as to the location. The total errors in diagnosis of tumors of internal organs were 32.44 per cent, or almost one-third of the total number of diagnoses; of these 17.35 per cent were mistakes as to the nature of the tumor, and 15.09 per cent errors as to the location of the primary neoplasm. The mistakes in diagnosis of sarcoma of internal organs amounted to 43.23 per cent. That this condition is not peculiar to Germany is evident from Wells' recent review of similar statistics (J. Am. M. Ass., 1923, lxxx, 737–740).

The editors point out that these discrepancies between clinical diagnosis and postmortem findings persist in spite of the most modern methods employed. Efficient treatment of malignant tumors is only possible on the basis of early diagnosis both as to the nature of the tumor and the organ primarily involved. To furnish criteria for such correct diagnoses is the principal purpose of this work.

The material presented in this volume may be indicated by the following brief summary: The article on tumors of the bronchi, lungs, pleura, mediastinum (thymus), heart and pericardium, chest wall and diaphragm, was written by Franz Krampf and F. Sauerbruch; that on the œsophagus by E. Rehn; on the abdominal wall, by E. Sonntag. Otto Kleinschmidt wrote the chapter on the pathological anatomy, diagnosis, symptomatology and differential diagnosis of carcinoma of the stomach; Payr, that on the treatment of carcinoma of the stomach. Victor Schmieden contributed the article on tumors of the intestine, and P. Clairmont that on tumors of the rectum. Malignant tumors of the liver, gall bladder, bile ducts, pancreas and spleen are discussed by E. Heller; and malignant tumors of the kidneys, renal pelvis, ureters and adrenals by H. Kuemmell F. Voelcker and H. Boeminghaus present the malignant tumors of the bladder, urethra, testicles and epididymis, prostate, seminal vesicles and penis; N. Guleke, the malignant tumors of the spinal column; and P. Frangenheim, the malignant tumors of the extremities. The volume closes with a chapter by Frangenheim on the relation of tumor formation and trauma. Each chapter is followed by a bibliography in which few references are given to papers by American workers.

The typography and general appearance of the two volumes thus far published are quite in keeping with the very high quality of their contents. Contributors, editors and publishers are entitled to high praise for supplying the profession with these works.

L. M. ZIMMERMAN.

A MONOGRAPH[2] on the subject of malignant disease of the testicle by Dr. Dew comprises a complete review of the literature and the author's observations of the study of 40 hitherto unreported cases of the disease. The book is of special interest to pathologists and to clinicians whose specialty may give them access to more than an occasional case.

In the classification of these tumors there are two main types, (1) the teratoma in which any one of the three types of cells may become malignant and tend to obscure the presence of the other two, and (2) the pure carcinoma which arises from cells of the seminal epithelium.

In the surgical treatment the point is stressed that simple orchidectomy is inadequate in most instances, but must be done in conjunction with a complete removal of the lymph chains and nodes known to be regularly and early involved.

Good anatomical, pathological and surgical plates are presented. HARRY CULVER.

[1] DIE KLINIK DER BOESARTIGEN GESCHWUELSTE. P. Zweifel und E. Payr. Vol. II. Brust- und Bauchorgane, Harn- und maennlicher Geschlechtsapparat, Wirbelsaeule und Extremitaeten. Leipzig: S. Hirzel, 1925.

[2] MALIGNANT DISEASE OF THE TESTICLE. By Harold R. Dew, M.B.B.S. (Melbourne), F.R.C.S. (Eng.), F.A.C.S. London: H. K. Lewis & Company, 1925.

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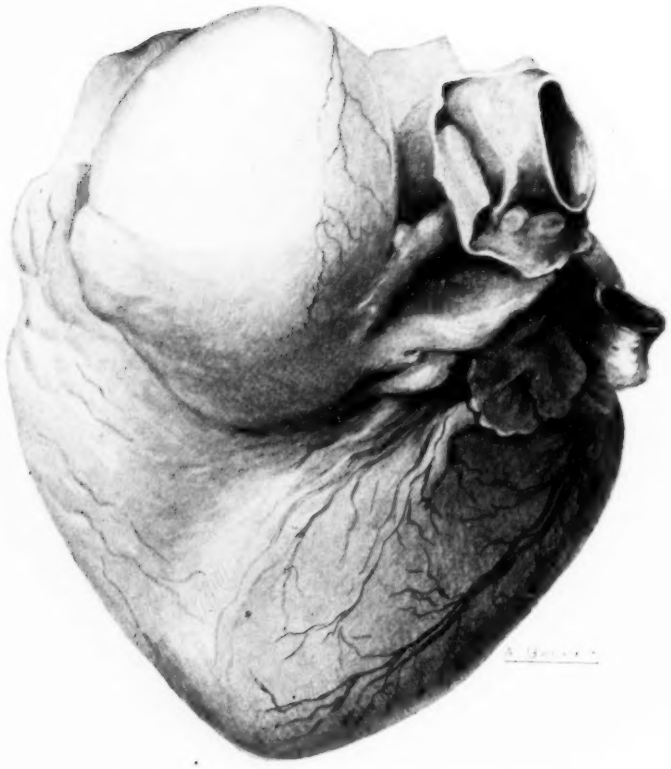

Plate I. Hydatid cyst of the heart in a boy of 9 years.

Hydatid Cysts in Children.—H. W. Mills.